IHF
Bayerisches Staatsinstitut für
Hochschulforschung und Hochschulplanung

Beiträge zur HOCHSCHULFORSCHUNG

4 | 2021

Special issue:

Treating patients, doing research, and teaching students.

Challenges and opportunities for university medicine

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Ausrichtung, Themenspektrum und Zielgruppen

Die „Beiträge zur Hochschulforschung" sind eine der führenden wissenschaftlichen Zeitschriften im Bereich der Hochschulforschung im deutschen Sprachraum. Sie zeichnen sich durch hohe Qualitätsstandards, ein breites Themenspektrum und eine große Reichweite aus. Kennzeichnend sind zudem die Verbindung von Wissenschaftlichkeit und Relevanz für die Praxis sowie die Vielfalt der Disziplinen und Zugänge. Dabei können die „Beiträge" auf eine lange Tradition zurückblicken. Die Zeitschrift erscheint seit ihrer Gründung 1979 viermal im Jahr und publiziert Artikel zu Veränderungen in Universitäten, Fachhochschulen und anderen Einrichtungen des tertiären Bildungsbereichs sowie Entwicklungen in Hochschul- und Wissenschaftspolitik in nationaler und internationaler Perspektive.

Wichtige Themenbereiche sind:

- Governance von Hochschulen und Forschungseinrichtungen,
- Steuerung und Optimierung von Hochschulprozessen,
- Hochschulfinanzierung,
- Qualitätssicherung und Leistungsmessung,
- Studium und Studierende, Umsetzung des Bologna-Prozesses,
- Übergänge zwischen Schule, Hochschule und Arbeitsmarkt,
- Forschung und wissenschaftlicher Nachwuchs, akademische Karrieren,
- Geschlechterungleichheiten in der Wissenschaft,
- Wissenschaft und Wirtschaft,
- International vergleichende Hochschulforschung,
- Wissenschaftsforschung.

Die Zeitschrift veröffentlicht quantitative und qualitative empirische Analysen, Vergleichsstudien, Überblicksartikel und Einblicke in die Praxis, die ein anonymes Peer Review-Verfahren (double blind) durchlaufen haben. Sie bietet die Möglichkeit zum Austausch von Forschungsergebnissen und stellt ein Forum für Hochschulforscher und Experten aus der Praxis dar. Neben Ausgaben, die das gesamte Spektrum der Hochschulforschung abbilden, erscheinen in regelmäßigen Abständen Themenhefte. Hierfür erfolgt in der Regel ein Call for Papers. Manuskripte können jederzeit in deutscher und englischer Sprache eingereicht werden.

Die „Beiträge" richten sich an Wissenschaftler, die sich mit Fragen des Hochschulwesens und seiner Entwicklung befassen, aber auch an politische Entscheidungsträger, Hochschulleitungen, Mitarbeiter in Hochschulverwaltungen, Ministerien sowie Wissenschafts- und Hochschulorganisationen.

Alle Ausgaben der „Beiträge zur Hochschulforschung" erscheinen in gedruckter Form und werden auf der Homepage unter www.bzh.bayern.de veröffentlicht, die einzelnen Artikel sind nach verschiedenen Kategorien recherchierbar.

Inhalt

Beyond the student phase: Clinical and research careers

Interprofessional training

Editorial

Through its unique triple mandate of delivering high-quality patient care, teaching (future) health professionals and performing innovative research, university medicine holds a key position at the intersection of science and health care. Physicians – not only at university – have to perform a multitude of professional tasks, i.e. clinical practice, evidence-based medicine, research, and interprofessional work. At the same time, technological innovation, economic constraints and other societal trends induce changes regarding the role of physicians. For these reasons, preparing medical students for the various tasks and challenges of a physician is becoming more and more challenging and the field of medical education has become a rapidly expanding discipline worldwide.

The present thematic issue of *"Beiträge zur Hochschulforschung" [Journal of Higher Education Research]* is dedicated to medical education as a strong and strongly growing field of research in Germany and other German-speaking countries. In 14 contributions, this volume aims to provide insights into current theoretical discussions and strands of empirical research in higher education in the medical domain.

In his introductory overview, *Olle ten Cate* analyses the evolvement of medical education as a scientific discipline from a historical perspective, looking at the last 70 years. Drawing from theories of discipline formation, he argues that medical education has developed its infrastructure, methods and communities to such a degree that it can legitimately call itself a discipline in its own right.

Following this historical overview, the volume continues with three contributions focusing on the topic of medical school admission procedures.

Josefine Wagner, *Alex Mommert* and *Jürgen Westermann* describe a newly developed admission procedure and examine whether it improves the selection of applicants with high levels of empathy, a quality that has been shown to be crucial for the medical profession. The authors draw positive conclusions regarding the efficacy of the procedure and advocate its further development and implementation.

Volkhard Fischer and *Ingo Just* discuss challenges connected with the admission of students into medical degree programmes at different universities. Since bedside teaching is one of the essential cornerstones of medical education, the maximum number of students is based on the number of patients treated at the university hospital. The authors present an improved and integrated formula to calculate admission capacities that allows for more flexibility in reaction to evolving training concepts.

In his position paper, *Markus Müller* addresses the current shortage of physicians in Austria which has led to calls for increasing the number of medical students and graduates. He reflects this perception considering the historical context of the Austrian health care system. In his view, a solution does not lie in increasing the number of students and graduates, but must address various long-standing shortcomings of the health care system itself.

In the subsequent section of the volume, three articles address topics related to motivational and attitudinal aspects of medical teachers and students.

In a research article, *Martin Gartmeier*, *Renato Alves Coppi, Fabian Zehner, Konstantina Koumpouli, Marjo Wijnen-Meijer* and *Pascal O. Berberat* examine attitudes and motivations of physicians in university hospitals regarding their role as clinical teachers. Latent class analyses show that clinical teachers are highly intrinsically motivated and prefer autonomous and constructivist viewpoints towards teaching. The authors conclude that university physicians are a good clientele for innovative teaching methods that relate to their preference structures.

Reversing the perspective, *Nikolaos Sapoutzis*, *Melanie Kalee*, *Anne E. Oosterbaan* and *Marjo Wijnen-Meijer* look at student evaluations to identify qualities of teachers and their teaching which are most important for fostering student motivation and appreciation for lecturers. Based on this, the authors develop recommendations for improving medical education practice.

The contribution by *Anja Kohlhaas*, *Ruben Zwierlein*, *Jost Steinhäuser*, *Christoph Strumann* and *Katja Goetz* focuses on attitudes of medical students towards management competencies. The results show that better knowledge about and positive attitudes towards entrepreneurial and leadership competencies are associated with a stronger tendency towards self-employment and, therefore, should be fostered.

The following three articles focus on specific didactical and curricular questions as well as classroom interventions in the context of competency-based teaching and learning.

Helen Jossberger, *Michael K. E. Scheumann*, *Hans Gruber*, *Bernhard M. Graf* and *York A. Zausig* analyse the effects of a video training unit on non-technical skills which have been shown to be relevant in emergency medicine (such as communication and task management). The authors conclude that their training, which focuses on negative knowledge and learning from errors, is highly effective and demonstrates the potential of this teaching method.

The use of innovative teaching methods supporting competency-based education is also addressed by *Stephanie Herbstreit*, *Cynthia Szalai*, *Daniela Mäker*, *Frank Herbstreit*, *Margarita Gestmann*, *Matthias Heue, Friederike Rademacher* and *Marcel Dudda*. The authors evaluate a course concept which trains medical students in clinical decision-making and introduces advanced digital diagnostic tools in a team-based learning format. Results demonstrate the educational benefit of the approach, but also highlight the importance of adequate preparation and support of students' self-directed learning.

From a more overarching perspective, *Ann-Kathrin Schindler*, *Christoph Schindler, Felix Joachimski, Alexander Eißner, Nicole Krapp* and *Thomas Rotthoff* propose a theoretical framework for competence development in undergraduate medical education. The authors identify the relevant determinants for competence development and suggest further steps to foster the development process towards authentic medical practice, thus providing a starting point for empirical testing and subsequent improvement on basis of their results.

In this section, three contributions deal with aspects of medical education that go beyond the student phase.

Since the quality of care is influenced by medical graduates' choice of specialty, *Elisabeth Narciß*, *Katrin Schüttpelz-Brauns* and *Udo Obertacke* conduct an extensive literature review on the factors which shape this decision. They further analyse how medical schools influence this decision through mandatory clerkships and internships. They conclude that decisions are malleable up to the final year of medical studies and that positive individual experiences substantially contribute to considering a previously less favoured subject for specialty training.

Given that health professionals are prone to burnout and the development of non-functional coping strategies, *Jan Kiesewetter*, *Bria Dimke* and *Johanna Huber* highlight the importance of early resilience training starting in medical school. The authors present results of an intervention study in which a ten-hour resilience training was able to reduce burnout scores and suggest an extension to other health professions and implementation throughout the medical career.

In the light of the importance of improving scientific competencies of medical graduates, *Nurith Epstein*, *Maike Reimer*, *Martin Gartmeier*, *Martin R. Fischer*, *Pascal O. Berberat* and *Johanna Huber* present a short and practical self-assessment tool in which medical graduates rate their level on central dimensions of medical research competence. Results indicate that the competence level is in the need of improvement, but that completing a doctorate can slightly raise the level of competence.

The last article addresses the issue of interprofessional training. Communication and cooperation between healthcare professionals – such as physicians, nurses, physiotherapists etc. – is crucial for optimal patient care. As a result, interprofessional training is increasingly integrated into the training of health care professions. *Marie-Luise Junghahn*, *Doreen Herinek* and *Jana Rückmann* discuss which teaching formats are suitable for a fruitful interprofessional learning experience and which challenges educators face in designing and implementing effective training and assessment methods.

Nurith Epstein, Martin Gartmeier, Yvette Hofmann, Johanna Huber,
Maike Reimer, Marjo Wijnen-Meijer

Health professions education scholarship: The emergence, current status and future of a discipline in its own right

Olle ten Cate

The study of medical education, as a domain of scholarly pursuit, has enjoyed a remarkably rapid development in the past 70 years and is now more commonly known as health professions education (HPE) scholarship. In this contribution, the author reviews the developments of the field from the perspective of Boyer's four criteria that determine scholarship: discovery, integration, application and teaching.
The author concludes that, given the scientific infrastructure which has emerged, HPE scholarship can arguably be considered a discipline in its own right, covering a unique niche, with inherent dependence on both medical and other health professional sciences on one hand and social sciences, including educational sciences, on the other.

1 The historical ouverture of scholarship in medical education

The education of medical students to become doctors, general practitioners or medical specialists, is a long route, requires hard work and involves abundant knowledge acquisition. This phrase may characterise in a nutshell how many people would summarise all they know about medical education, unless they have personal involvement. Most educational scientists, as well as most biomedical scientists, involved in educational or medical scholarship may not realise the richness of the intersecting field of medical education scholarship, currently subsumed under the broader term of "health professions education".

This article was independently solicited for special issues of the *Beiträge zur Hochschulforschung [Journal for Higher Education Research]* and *FASEB BioAdvances* (ten Cate, 2021), with quite different audiences, both of which are, as we estimate, not deeply informed about medical education.

The purpose of this contribution is to inform educational scientists and biomedical scientists about the intersecting domain of health professions education, elucidating its history and current status as a rapidly emerging scholarly domain.

The intersection of two fundamental pillars of a thriving society – population health and population education – is the art of educating doctors and other health professionals to serve the health of populations. Medical education has always enjoyed the dedicated

interest of physicians and educators. Mythology teaches us that the first renowned medical student and educator, Asclepius, son of Apollo and Coronis, had been educated himself in the art of medicine by the centaur Chiron and had learned about healing and resurrection from a snake who became his company along with a magical rod (Figure 1). Rod and snake became and remained the most important symbols of medicine throughout the ages until today, as witnessed by the many logos of medical associations around the world. It should be acknowledged that Chiron and Asclepius were not only famous for their medical knowledge, but also known for their educational skill.

Figure 1: Hendrick Goltzius (1558 – 1617): Apollo, about to entrust centaur Chiron with the education of Asclepius [Courtesy National Gallery of Art, Washington DC]

In the 21st century, medical and biomedical sciences have become a major industry through specialised hospitals, laboratories, universities and commercial enterprises. Education, while for many ages focused on primary schooling and handicraft for the youth, has developed in the past century in industrialised societies with secondary education for most and tertiary education for many citizens with important scientific foundations. The science of education has developed strongly in the 20th century.

Medical education itself has been a respected art throughout history. Famous medical scholars and educators through the ages include Hippocrates, Celsus, Galen, Andreas Vesalius, Herman Boerhaave, William Osler and William Halsted as prime examples until the early 20th century (Bliss, 1999; Lindeboom, 1968; Ludmerer, 1999; Lyons &

Petrucelli, 1987), and most medical schools take pride in some of their own professors of the past, honouring their names and faces in portrait galleries and lecture halls.

Figure 2: Rembrandt van Rijn: The Anatomy Lesson of Dr. Nicolaes Tulp, 1632 [Courtesy Mauritshuis, The Hague, the Netherlands]

2 The birth of medical education as a domain of scholarly study

While the art of teaching medicine became widely acknowledged over the centuries, the study of medical education, with its focus on methods and effectiveness, independent of individual educators, became a focused domain of study only recently. Its emergence can be considered to have started primarily from the mid-20th century, linked to the development of new approaches to the medical curriculum, with new methods, objectives and content. With the rapid increase of medical schools around the world, from 566 in 1953 to 2,881 in 2018 (Rizwan et al., 2018), the interest in scholarship of medical and, later, health professional education has developed remarkably.

Usually many factors together, operating coincidentally, enable such an emergence of a discipline. Medical education historian Ludmerer rightly qualifies the years around 1920 as the start of modern medical education in the United States (Ludmerer, 1985), shortly after Flexner's famous but critical 1910 Carnegie Report, which forced US schools to either close or modernise (Flexner, 1910), – while less influential in Europe (Custers, 2010). The first issue of the *Journal of Medical Education* appeared in 1920,

but, frankly, the start of medical education development and research as a scholarly endeavour may be better located around 1950, the year that the Western Reserve University established a committee to modernise their medical curriculum, followed by the University of Colorado a few years later, two endeavours that were extensively documented (Hammond et al., 1959; Williams, 1980) and therefore enable to pinpoint the start of a movement. With George Miller, Stephen Abrahamson, Hilliard Jason, Christine McGuire and Howard Barrows at universities in New York, Michigan, Illinois and California, prominent examples of a first generation of medical education scholars emerged, together constituting a new discipline about 70 years ago, when the first distinct units of education research were established in medical schools (Abrahamson, 1991; Miller, 1970). In parallel, in the 1950s, medical education became an external object of study by social scientists, who produced influential psychological and sociological reports of what it means to become a doctor (Becker et al., 1961; Eron, 1955; Merton et al., 1957). Outside the United States, McMaster University in Canada, the University of Dundee in Scotland, and Maastricht University in the Netherlands are among the first institutions with units for scholarship in medical education in other countries.

A few individuals, teachers, researchers or even centres with a specific interest in a particular domain of scientific pursuit may not yet make the field a recognisable scholarly domain. So, the question is, what would be needed to call someone a medical or health professions education (HPE) scholar[1] and to call a community of such individuals *scholarly*? Ajjawi and colleagues found that an environment fostering researcher identity formation, collaborative relationships and protected time for research is likely to make health professions education scholarship thrive (Ajjawi et al., 2018). To create this identity, the scholar should belong to a community with specific characteristics. Scholarly communities may be defined using Ernest Boyer's widely cited four criteria that, together, should determine scholarship: discovery, integration, application and teaching (Boyer, 1990).

Discovery is the production of new ideas and insights, things that are worth knowing, if only to satisfy scientific curiosity. A significant number of scholars should engage in active HPE research and yield research findings that advance the domain to give this criterion weight.

[1] Historically, medical education has first developed a scholarly tradition, and is currently transitioning to or being renamed as the broader field of health professions education, as nursing, veterinary medicine, dentistry, pharmacy, and other health professions have become scholarly active, predominantly in the 21st century. With the establishment of a new journal *Advances in Health Sciences Education* in 1995, the labeling of this domain of scholarship began to shift from *medical* toward health sciences or *health professions*. In this paper, both terminologies are being used more or less interchangeably, depending on the context.

Integration is giving meaning to isolated facts and connecting new findings with what is already known, within and across disciplines. Coherence must be established, by relating to or involving social and other sciences and by various research synthesis efforts, if only to avoid wheels being reinvented. A body of accepted knowledge is to be built through integration.

Application relates to the usefulness of findings to solve problems. Scholarship must "*prove its worth not on its own terms but by service [to society]*" (Boyer, 1990, p. 23). It should be visible through improved medical and health professions education curricula in practice, through improved competence of graduates and, ultimately, through better health care.

Teaching, as "*the highest form of understanding*" (Boyer, 1990, p. 23), involves scientific communications and the education of future scholars. While Boyer had students and individual interactions in mind, teaching can also be done through conferences, publication of books, papers, and modern media. Teaching in its broader sense would be characterised by the sufficient and sustained training of next generation scholars and sufficient publications, conferences, associations that would characterise the existence of a true interactive scholarly community.

Glassick (Glassick, 2000) and O'Brien et al. (O'Brien, Irby et al., 2019) have elaborated Boyer's criteria for individual scholars in health professions education scholarship units, but the criteria may also apply to the scholarly HPE community at large. In this contribution, I will use these criteria to examine the domain of health professions education scholarship in general.

3 Does health professions education qualify as a scholarly domain or discipline?

Academic disciplines and subdisciplines are not unequivocally defined. They are usually acknowledged by universities and categorised in faculties, departments and academic courses, sometimes by scientific societies and sometimes by law, when licensing and privileging is restricted. But beyond formal, institutional statements, the dynamics among scholarly individuals, with their interactions and activities, make up what a scholarly community or discipline is. Social Identity Theory posits that for individuals it is important to belong to a group that provides them with identity (Hornsey, 2008). Social identification supports self-esteem and group behaviour (Turner, 1982), as people like to know and take pride in what they are, be able to explain that to others, use it for purposes as seemingly futile as business cards and stationary but also to connect with likeminded others. A defined identity in a scholarly community can also affect promotions in an organisation, and even funding of research. Defining a discipline is not trivial.

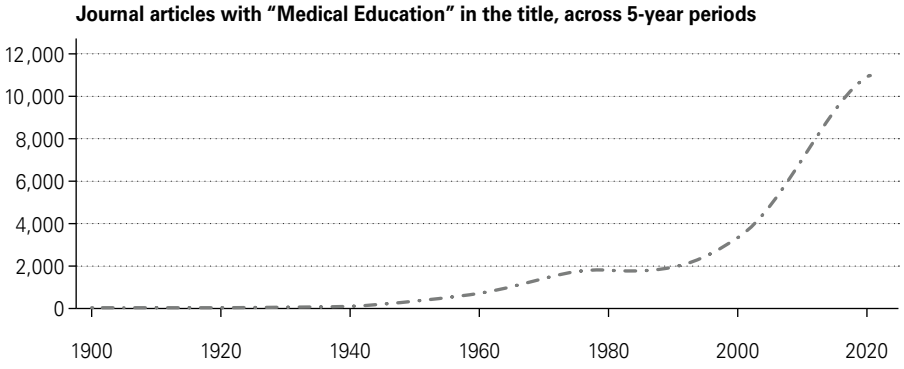
3.1 Discovery

To meet the *Discovery* criterion, there must be sufficient researchers who are active discoverers. We do not know how many HPE researchers exactly are active in 2021 worldwide. However, there are some proxy indicators of growth in volume since 1950. If an active researcher would be someone who publishes at least one journal article per year over a sustained period of time, say 10 years, and discovery would be defined as the addition of a fact or insight to the body of knowledge of health professions education, it is worth looking at the number of published papers and their authors at different moments in time.

In 1980, there were three dedicated medical education journals: the *Journal of Medical Education* (now called *Academic Medicine*), *The British Journal of Medical Education* (now called *Medical Education*) and *Medical Teacher*. The oldest one (*Journal of Medical Education*) featured about 450 authors across the year of 1980 (12 issues), including non-researchers but also some who published more than once. In 2020, the estimated number of authors contributing to the 12 issues of this same journal has about tripled. A different proxy of growth is shown in Figure 3, comparable to graphs presented by Jason in 2018 (Jason, 2018). The combined words "medical" and "education" in journal article titles listed on Google Scholar shows a 10-fold increase in less than 50 years. In addition, in those years the number of international peer reviewed medical education journals has steadily grown from 3 to about 35, and about 90 in total predominantly publish on health professional education more broadly (including dedicated education journals in specialty areas such as anatomy, physiology or biochemistry, and other health professions)[2]. If each of these would feature only 100 authors per year and every scholar would produce one scholarly paper per year (both are very conservative estimates), the domain would have close to 100,000 authors. Rotgans estimated in 2010 that 10,000 articles had appeared in the six most common medical education journals in the 12 years prior (Rotgans, 2012). Taking an average number of three authors per paper and multiplying by three for the increased number of current quality journals leads to a similar figure. The quality of the numerous medical education journal articles may not all meet scholarly standards (Albert et al., 2007), but if only 20% would be regarded as truly scholarly, the combined authors would establish a community of at least 20,000 true health professions education scholars. The critical mass for a scholarly community as criterion seems, arguably, amply met.

[2] A list can be obtained from the author.

Figure 3: Increase of "medical education" in journal article titles



In addition to mass, generally acknowledged advances in the domain should support discovery. If medical education would not be "better" than 70 years ago, then Boyer's discovery criterion would probably not be met. This criterion is much more difficult to measure or estimate, since there is no measurement instrument to establish whether the 2020 medical graduates are better equipped for clinical practice than in 1950.

Advances and discoveries in educational research often focus on new theories and research methods, rather than evidence-based education advances which stepwise and undeniably show improved education outcomes. New, undisputed facts on which theories and practice can build, such as in physics, chemistry and medicine, are rare (de Landesheere, 1985; Schunk, 2012). Sawyer contends that *"the history of scientific approaches to [general] education is not promising"* and cites the ongoing debate about whether education is a science or an art (Sawyer, 2006, p. 15). Others, however, have established evidence-based principles of learning and instruction (Ambrose et al., 2010; Bransford et al., 2000; Colvin Clark & Mayer, 2016). Different from bio-medical or engineering advances that may be expected to "work" every time new procedures or therapies are applied appropriately, the effects of educational principles are less predictable. Not only do many variables, often not controllable, interfere with outcomes of education, the "system of education" itself is complex and adaptive. A new, "proven" teaching method will, when applied, evoke emotions, motivations and intelligent responses by students. Students, highly motivated to become doctors, will simply do whatever they feel is needed to reach their target, no matter which curricular methods and demands are applied; they are not a black box, or a passive object that can be manipulated, but have a free will to shape their learning pathway to some extent (ten Cate et al., 2011; Teunissen & Westerman, 2011). For instance, excellent

lectures may decrease the students' inclination to self-directed study, to the point that on tests they may perform worse than students who were forced to figure out the complexities of the content matter themselves (ten Cate, 2001). What further complicates educational research is that outcome measures of educational interventions are difficult to determine. While knowledge and skills demonstrated at exams may be considered such outcomes, the true purpose of education, such as in medicine, is effective performance in practice and improved clinical outcomes, which are often determined by biomedical and technical advances, context and teamwork, not just by improved individual skills (Bleakley, 2006; Schumacher et al., 2020).

Despite these difficulties, however, current scholars in HPE would likely agree that many advances have certainly been made and turned into established educational practices in the health care domain. *Discoveries* in medical education are more often new educational or assessment methods, rather than findings supporting generalised theoretical truths. While undisputable evidence of educational innovations with guaranteed success is hard to establish (Regehr, 2010), several changes in medical education, based on credible theory, have had profound influence on medical curricula in the past 50 years and would now be viewed as recommended approaches.

Table 1 shows examples across a 50-year period of findings and educational advances in medicine, *discoveries* if you will, which can be attributed to scholars in the field of health professions education. A limitation is that the table does not do justice to the important scholarly work of many medical educators not associated with single identifiable concepts, findings or innovations. Many other studies have improved medical training, such as applying advanced skills training and advanced assessment techniques, deliberate practice, mastery learning, clinical reasoning tests, instruments to measure clinical learning environments, physical space for education, studies to correlate lapses in professional behaviour with later adverse practice events, studies on theories of workplace learning, motivation, cognitive load in medical education, conditions for interprofessional education, studies on burn-out and depression, and many other innovations that were tried on smaller scale. Still other scholars have helped sharpen the mind by debunking myths about medical education (de Bruin, 2020; Lingard, 2016; Norman, 2018; Paton et al., 2020), or provided major overviews of strengths and weaknesses in medical education, and urged for reform (Cooke et al., 2010; Frenk et al., 2010).

Table 1: Twenty examples of influential innovations and advances in medical education across 50 years of scholarly work

Innovations, concepts and findings	Scholars associated with this innovation	Year of origin/ publications
Simulated and standardised patients	Howard Barrows, Stephen Abrahamson	1964[1]
Objective Structured Clinical Examination	Ronald Harden	1975[2]
Problem-based learning	Howard Barrows, Henk Schmidt	1975[3]
Content or case specificity of clinical expertise	Arthur Elstein, Geoff Norman	1978[4]
Progress testing	Cees van der Vleuten	1982[5]
Key-feature items to assess clinical competence	Geoff Norman, Georges Bordage, Gordon Page	1984[6]
Faculty development in medicine	Kelley Skeff, Yvonne Steinert	1984[7]
Clinical teacher knowledge and reasoning	David Irby	1991[8]
Longitudinal Integrated Clerkships	Lori Hanson, David Hirsh, Ann Poncelet	1992[9]
Hidden curriculum	Frederic Hafferty	1994[10]
Mini-Clinical Evaluation Exercise	John Norcini	1995[11]
Outcome and competency-based education	Jason Frank, Ronald Harden, Carol Carraccio	1996[12]
Teaching and assessing professionalism	Richard and Sylvia Cruess, Brian Hodges	1997[13]
Interprofessional education	Scott Reeves, Hugh Barr	1998[14]
Simulation technology	Barry Issenberg, William C. McGaghie, Amitai Ziv	1999[15]
Multiple-Mini Interview selection method	Kevin Eva	2004[16]
Entrustable Professional Activities	Olle ten Cate	2005[17]
Programmatic Assessment	Cees van der Vleuten, Lambert Schuwirth	2005[18]
Learner burn-out and depression studies	Tait Shanafelt, Lotte Dyrbye	2005[19]
Relating education to clinical outcomes	David Asch	2009[20]

[1](Barrows & Abrahamson, 1964), [2](Harden et al., 1975), [3](Barrows & Mitchell, 1975; Barrows & Tamblyn, 1980; Norman & Schmidt, 1992), [4](Elstein et al., 1978; Norman et al., 1985), [5](Verwijnen et al., 1982), [6](Bordage & Page, 2018; Bordage & Page, 1987), [7](Skeff et al., 1984; Steinert, 2000), [8](Irby et al., 1991), [9](Hanson & Talley, 1992; Poncelet & Hirsh, 2016), [10](Hafferty & Franks, 1994), [11](Norcini et al., 1995), [12](Carraccio et al., 2002; Frank & Jabbour, 1996; Harden et al., 1999; McGaghie et al., 1978), [13](Cruess & Cruess, 1997; Hodges et al., 2011), [14](Barr, 1998; Reeves et al., 2013), [15](Issenberg et al., 1999; Ziv et al., 2000), [16](Eva et al., 2004), [17](ten Cate, 2005), [18](van der Vleuten & Schuwirth, 2005), [19](Dyrbye et al., 2005), [20](Asch et al., 2009; Asch et al., 2014).

3.2 Integration

Integration pertains to the consolidation of new findings within and across disciplines. Of the exemplary advances shown in Table 1, many had significant impact in a wider community, such as problem-based learning (Loyens et al., 2012). Some advances, such as the introduction of Patient Management Problems for the assessment of clinical reasoning skill (by Christine McGuire and colleagues) were abandoned (Norman, 2011) and replaced by newer methods after research had revealed inadequacies. But Key-Feature items (more or less their successor) (Bordage & Page, 1987) would have

never been introduced without this precursory grounding. This example of consolidation is a testimony of a self-developing scholarly tradition in medical education.

Consolidation has translated in a steady proliferation of dedicated health professions education scholarship units that build a tradition of research (Davis et al., 2005). In the 1980s such units were just few in North America and Europe, but in 2000, North America had 61 units (Albanese et al., 2001) and in 2020, there are countless units in several countries worldwide. The Society of Directors of Medical Education Research currently lists 78 members directing such units. These typically employ scientists, scholarly educators and administrative leaders, involved in research, faculty development (teaching) and service (Varpio, Gruppen, et al., 2017; Varpio, O'Brien, et al., 2017).

Integration also speaks to the cross-fertilisation of different domains of sciences. Health professions scholarship has hugely benefited from the social sciences. Norman has qualified the contributions made by scholars with a non-medical background as made by "immigrants" in the health professions domain, such as psychologists, sociologists, and psychometricians, adapting their skills to serve HPE (Norman, 2011). Only few of these remained outside observers; rather, PhD level social scientists were hired by medical schools, and integrated in their communities in close collaboration with medical and biomedical experts. The number of journal article titles combining "medical", "education", and "theory" has exponentially grown in the six decades since 1960 (3→7→11→31→96→195) (Google Scholar). The integration made a further step in what Norman called "third generation" scholars, not immigrants but medically trained, and supplemented with HPE scholarship training in a new, own tradition of dedicated HPE Masters and PhD education, with its pros (being highly specialised without an ivory tower stance) and cons (with limited depth of experience and background in other disciplines) (Norman, 2011). Another important influence regards the methodology of research. HPE research has seen a significant increase of qualitative studies (Kennedy & Lingard, 2006; Thompson-Burdine et al., 2021), reflecting the awareness of the limitations of controlled experiments (Norman, 2003; Regehr, 2010).

Are there limitations of Boyer's sense of integration with regards to health professions education scholarship? One hallmark of maturation of a professional domain, the establishment of specialised journals, paradoxically shows a hesitation to integrate with other disciplines. Comparatively very little about health professions education is published in journals of the social sciences. HPE scholars may be less inclined to read and publish in these journals, and readers of these journals may be less interested in HPE. The largest community of educational scholars is arguably the American Educational Research Association (AERA), with an annual meeting that brings together 10,000 to 15,000 scholars. HPE scholars are represented in AERA, but interact largely within one division of it, that of *The Professions*, dominated by HPE scholars. On the

other hand, some topics may simply be better represented in the HPE literature than in other educational literature. As an example, van Dijk et al., searching for frameworks of university teaching tasks, identified 46 in an extensive literature review, 18 of which pertained to the medical faculty and 6 to other health professions including nursing, dentistry, pharmacy and midwifery (van Dijk et al., 2020).

To conclude, integration has happened internally, through consolidation of innovations and findings, but integration with other disciplines has been limited.

3.3 Application

In health professions education scholarship, research and development go hand-in-hand. *Application* is a core characteristic. The vast majority of scholars involved in HPE research have roles in education, either as clinicians, as teachers, or both; as course or programme directors or as administrative officers. HPE researchers are very often active teachers, active faculty developers or active curriculum and course developers. Many scholarly HP educators have initially built a career in patient care and developed as scholarly educators only at a later stage as a second career.

The reason why the application criterion of scholarship in HPE may be stronger than in other higher education domains is a clear societal desire for high quality health care. Health care affects everyone, and requires societal trust to operate, a trust that primarily focuses on care providers and their presumed education. The many reports, across several decades, advocating for improvement of medical training led Christakis to conclude in 1995 that they all *"articulate a specifically social vision of the medical profession, in which medical schools are seen as serving society [...] with a remarkable consistency, [...] to better serve the public interest, to address physician workforce needs, to cope with burgeoning medical knowledge, and to increase the emphasis on generalism",* signalling a repetition of similar recommendations since 1910 (Christakis, 1995, p. 708), conclusions that easily extend to subsequent calls for medical education reforms after 1995 (Cooke et al., 2010; Frenk et al., 2010; Irby et al., 2010).

Health professions education scholarship is an exemplar of an applied science and cannot be viewed as a pure science because of its continuous focus on application. Of all current publications in the major HPE journals, the majority are not research reports, but perspective articles, guidelines, and reviews. They serve to advance education and are highly useful, and show that application is central to the HPE scholarly domain.

3.4 Teaching and scholarly communication

Boyer's fourth criterion of scholarship is *Teaching*, or, interpreted more broadly, the communication of knowledge, insight, and discovery, to the community at large and to junior generations of scholars. Not only the number of journals and publications increased significantly; local, national and international conferences in medical education – virtually non-existent before 1970 – increased rapidly (Table 2).

Table 2: Major international HPE conferences

Conference	Hosted by	attendees*
AMEE conference	Association of Medical Education in Europe	3,808
Ottawa conference	Association of Medical Education in Europe	~1,000
IAMSE conference	International Association of Medical Science Educators	660
APMEC conference	National University of Singapore in international collaboration	1,421
ICME conference	Riphah International University Pakistan in international collaboration	908

*2019; 2018 for biennial Ottawa conference.

The largest international HPE society is the Association of Medical Education in Europe (AMEE). Its annual conference has grown since its inception in 1973 into a global conference with a majority of attendees from outside Europe (Wojtczak, 2013). AMEE offers a variety of other services to foster the quality of medical and health professions education (journals, webinars, certificate courses, resources including guidelines and reviews, awards, prizes and small grants, fellowship member options). Their website lists 37 smaller active national and international societies and associations for medical or health professions education (www.AMEE.org). Many of these also hold annual national or regional conferences, some exceeding international conferences in size.

While the object of educational scholarship includes teaching, teaching new generations of scholars is something different. The first generations of HPE scholars with a medical background have trained themselves in educational methods or spent time to obtain an advanced degree in schools of educational or social sciences. In the 1990s, advanced academic degree programmes began to be offered by units of health professions education scholarship, and serious attention for teacher careers in medical schools emerged (Irby & O'Sullivan, 2018). The establishment of dedicated professorial chairs and associate professor positions in health professions education, providing an alternative career opportunity for clinical and non-clinical faculty members (Alexandraki & Mooradian, 2011), and the establishment of Academies as educational communities within medical schools for early career or distinguished educators (Irby et al., 2004) has further fostered this. Master's and PhD programmes enable this continued professional development in scholarship: The number of master's level programmes

in HPE increased from 7 in 1996 to 76 in 2012 (Tekian & Harris, 2012) and 139 in 2020 (www.faimer.org) and the number of structured doctoral programmes was calculated to be 24 in 2014 (Tekian, 2014) and 26 in 2020 (www.faimer.org). The numbers of students trained in these units also expanded significantly. As an example, the number of active PhD students at Maastricht University's School of Health Professions Education increased in the past decade from 25 to 100 (van Merriënboer, n.d.); expanded international collaborations foster such increases as programmes become less and less confined to one location (University of California San Francisco School of Medicine website). Measured by productivity per medical school, i.e. considering the size of the country, Canada and the Netherlands have shown the highest relative research productivity across the past decade and a half, and often provided senior authorships on journal articles (Table 4). Senior (last) authorships may be interpreted as a sign of international research mentorship (Table 3).

Table 3: Publications during the period of 2006–2019 in four journals according to the country of the first author

	USA	CA	UK	NL	AUS/ NZ	Others	Total
Journal data a-d = total 2006–2011*	1,778	423	603	239	187	555	3,785
Journal data 2012–2019							
a. Medical Education 2012–2019	247	277	215	103	155	128	1,145
b. Academic Medicine 2012–2019	1,732	257	35	62	22	49	2,163
c. Medical Teacher 2012–2019	384	204	286	123	154	317	1,468
d. Adv.Health Sci.Educ. 2012–2019	100	146	54	90	56	105	559
total 2006–2019	4,241	1,307	1,193	617	574	1,154	9,086
Mean per year	302.9	93.4	85.2	44.1	41.0	82.4	649.0
Percentage of total	46.7	14.4	13.1	6.8	6.3	12.7	100.0
Number of medical schools**	197	17	61	8	27	2,571	2,881
Relative Publication Productivity	21.5	76.9	19.6	77.1	21.3	0.4	3.2

*Jaarsma et al., 2013.
**WFME/Faimer World Directory of Medical Schools, 2018; Rizwan et al., 2018.

Table 4: First and last authors of publications during 2006–2011 according to nationality

	USA	CA	UK	NL	AUS/ NZ	Other
Publications with first author from this country	4,241	1,307	1,193	617	574	1,154
Publications with last author from this country	2,182	808	505	423	328	485
Relative difference	0.51	0.62	0.42	0.69	0.57	0.42

In some countries, such as the Netherlands, professorial chairs include the formal right and expectation to supervise doctoral students in their domain of expertise, individually or in structured programmes. In health professions education, the increase of such chairs has had a catalytic effect of increased numbers of PhD students in HPE, which, combined with government funding of university research based on PhD graduations, may explain the prolific production of health professions education research in the Netherlands (Jaarsma et al., 2013).

Boyer's *teaching* criterion, no doubt, has been met, not only locally, but also at the international level.

4 Conclusion and outlook

The analysis of the development and current status of health professional education scholarship would undeniably qualify it as meeting all of Ernest Boyer's criteria of mature scholarly discipline. HPE scholarly units can become academic departments and a relevant question is then, where in universities such departments or units belong (Varpio, Gruppen, et al., 2017). Rather than in faculties or departments of social or educational sciences, schools in the health professions have established and hosted such units and should host them. Being situated at close vicinity to the practice of health care seems to have been a critical condition for these units to flourish, combined with the insights of the social sciences (Schmidt & Mamede, 2020). HPE research should be best conducted by scholars with a mindset to approach what it is to *think, act and feel* like a physician, nurse or other health professional, in other words to possess, or at least sympathise, with professional identities in health care (Cruess et al., 2014).

The growth of health professions education scholarship activities and interest since the mid-20th century (journals, publications, conferences, HPE research and development centers, scholars) has out-paced similar developments in other higher education domains. In other traditional university faculties, such as Science, Law, Humanities, Social Science, Economics, domain specific educational scholarship hardly exists. They may have a "journal of X education" but usually not a scholarly community. As an example, in a recent elaborate article on the cognitive challenges of teaching in the Journal of Economic Education, not one of the 126 citations referred to an economic education source, not even to a paper in the journal itself (Chew & Cerbin, 2021). While mathematics education and teacher education have journals and scholarly communities, their focus is not primarily on the education of mathematicians and educational scientists but on primary and secondary education. One may wonder why the education of medical doctors and other health professionals has proven such a fertile soil for scholarship. Likely, it is the need for a well-trained health care workforce with

extensive knowledge and skills that is virtually undisputed among members of any society. This visibility of health professionals with their societal impact, professional esteem, and clarity of occupations, now combined with insights from educational theory and research methodology that lacked 70 years ago, may have established the ground for this domain-specific educational scholarship.

Speculating what HPE scholarship will look like in the future must take the expected developments of the object of this scholarship into account. Healthcare will definitely change, not only because of scientific and technological advances, but also because of demographic and epidemiologic changes (Wachter, 2015; Woolliscroft, 2020). Demographics, artificial intelligence, genomics, regenerative medicine, and precision medicine have been called disruptors of current healthcare (Woolliscroft, 2020). The recent disruption by the Covid-19 pandemic has stirred further thinking about the future of health care and education, e.g. to include tele-healthcare provision, bringing new demands for training and assessment (Wijesooriya et al., 2020). A recent international survey among 51 health professions thought leaders revealed significant upcoming developments, in competency-based, time variable education; in simulation; in methods and criteria for selection for undergraduate and postgraduate education; increased global collaboration and exchange; more focus on skills in prevention, and interprofessional, team-based and community-based care and on a changing relationship with patients (O'Brien, Forrest et al., 2019). The continuous super-specialisation and fragmentation of the medical domain poses threats to education that must be dealt with. Calls for more integrated, coherent, holistic, systematic approaches to biology, health care and its education can be found in the literature.

While these will all affect the work of health professions education scholars, HPE scholarship in itself will likely continue to show quantitative and qualitative development. In their analysis of the future of medical education, Bleakley et al. (Bleakley et al., 2011, p. 222–225) elaborate a five-point agenda for improvement of medical education research (slightly amended): (1) a focus on conceptual questions and clarifications and deciding on what counts as evidence, (2) building programmes of systematic research rather than conducting just opportunistic studies, (3) more rigorous outcome-based research, (4) building better expertise in combined qualitative and quantitative (mixed methods) research and (5) creating a productive dialogue between the academic and clinical communities. The quality of research is increasing, if measured by the number of knowledge syntheses, methodology guidelines and theory papers that have appeared in the past decades. While review studies have exploded in medical education (Maggio et al., 2021), rigorous replication studies, rather than reinventing wheels, appear infrequently, as is the case in biomedical sciences (Ioannidis, 2017). Bleakley's recommendations remain valuable and may be supplemented with a stronger faculty development focus to breed future generations of scholars.

Asclepius would be surprised to know how his symbols of snake and rod as well as the obligation to teach in Hippocrates' oath have led to a lively community of scholarly educators several millennia later. The common pursuit, then and now, for the best qualified health professionals has not changed. While researchers and scholars develop visions suggesting that the ultimate goal of a competent health care workforce may be attainable and fuel the continued innovation in medical education, it may be the *pathway* rather than an attainable endpoint that characterises scholarship. While "the competent health professional", molded by optimal education, may seem a Holy Grail, the quest for it is served by scholarship according to Boyer's criteria. The pathway shows ups and downs (Touchie & ten Cate, 2016), and the interest of schools, hospitals and regulatory bodies in this competent workforce, has led, in the words of Woolliscroft, to "unintended consequences" of financing, efficiency, and legal constraints (Woolliscroft, 2020). Scholars are needed to discern these consequences and recommend routes to overcome them. This amalgam of dynamics is bound to keep challenging future scholars to create and test ongoing innovations in health professions education, to the benefit of learners, teachers, clinicians, patients and society.

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References

Abrahamson, S. (1991). Offices of Research in Medical Education: "What have you guys ever done anyway?". *Academic Medicine*, *66*(9), 89–92.

Ajjawi, R., Crampton, P.E.S., & Rees, C.E. (2018). What really matters for successful research environments? A realist synthesis. *Medical Education*, *52*(9), 936–950. https://doi.org/10.1111/medu.13643

Albanese, M.A., Dottl, S., & Nowacek, G.A. (2001). Offices of Research in Medical Education: Accomplishments and Added Value Contributions. *Teaching and Learning in Medicine*, *13*(4), 258–267. https://doi.org/10.1207/s15328015tlm1304_08

Albert, M., Hodges, B., & Regehr, G. (2007). Research in medical education: balancing service and science. *Advances in Health Sciences Education: Theory and Practice*, *12*(1), 103–115. https://doi.org/10.1007/s10459-006-9026-2

Alexandraki, I., & Mooradian, A. (2011). Academic advancement of clinician educators: why is it so difficult? *The International Journal of Clinical Practice*, *65*(11), 1118–1125. https://doi.org/10.1111/j.1742-1241.2011.02780.x

Ambrose, S., Bridges, M., DiPietro, M., Lovett, M., & Norman, M. (2010). *How Learning Works – Seven Research-Based Principles for Smart Teaching* (1st ed.). John Wiley & Sons, Inc.

Asch, D.A., Nicholson, S., Srinivas, S.K., Herrin, J., & Epstein, A.J. (2014). How do you deliver a good obstetrician? Outcome-based evaluation of medical education. *Academic Medicine*, *89*(1), 24–26. https://doi.org/10.1097/ACM.0000000000000067

Asch, D., Nicholson, S., Srinivas, S., Herrin, J., & Epstein, A. (2009). Evaluating obstetrical residency programs using patient outcomes. *JAMA: Journal of the American Medical Association*, *302*(12), 1277–1283. https://doi.org/10.1001/jama.2009.1356

Barr, H. (1998). Competent to collaborate: towards a competency-based model for interprofessional education. *Journal of Interprofessional Care*, *12*(2), 181–187. https://doi.org/10.3109/13561829809014104

Barrows, H., & Abrahamson, S. (1964). The Programmed Patient: A Technique for Appraising Student Performance in Clinical Neurology. *Journal of Medical Education*, *39*(8), 802–805.

Barrows, H., & Mitchell, D. (1975). An innovative course in undergraduate neuroscience. Experiment in problem-based learning with "problem boxes." *British Journal of Medical Education*, *9*(4), 223–230.

Barrows, H., & Tamblyn, R. (1980). *Problem-based learning*. Springer Publishing Company, Inc.

Becker, H.S., Geer, B., Hughes, E., & Strauss, A.L. (1961). *Boys in White. Student Culture in Medical School*. University of Chicago Press.

Bleakley, A. (2006). Broadening conceptions of learning in medical education: the message from teamworking. *Medical Education*, *40*(2), 150–157. https://doi.org/10.1111/j.1365-2929.2005.02371.x

Bleakley, A., Bligh, J., & Browne, J. (2011). *Medical Education for the Future – Identity, Power and Location*. Springer Science+Business Media BV.

Bliss, M. (1999). William Osler at 150. *Canadian Medical Association Journal*, *161*(7), 831–834. https://doi.org/10.1001/jama.282.23.2252

Bordage, G., & Page, G. (2018). The key-features approach to assess clinical decisions: validity evidence to date. *Advances in Health Sciences Education*, *23*(5), 1005–1036. https://doi.org/10.1007/s10459-018-9830-5

Bordage, G., & Page, G. (1987). An alternative to PMPs: The "key feature concept." In I. Hart & R. Harden (Eds.), *Further developments in assessing clinical competence* (pp. 59–75). Can-Heal Publications.

Boyer, E.L. (1990). *Scholarship reconsidered – priorities of the professoriate*. Carnegie Foundation for the Advancement of Teaching.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (Eds.). (2000). *How People Learn*. National Academy Press.

de Bruin, A. B. H. (2020). Debunking myths in medical education: The science of refutation. *Medical Education*, *54*(1), 6–8. https://doi.org/10.1111/medu.14028

Carraccio, C., Wolfsthal, S. D., Englander, R., Ferentz, K., & Martin, C. (2002). Shifting paradigms: from Flexner to competencies. *Academic Medicine : Journal of the Association of American Medical Colleges*, *77*(5), 361–367.

ten Cate, O. (2001). What Happens to the Student? The Neglected Variable in Educational Outcome Research. *Advances in Health Sciences Education*, *6*(1), 81–88. https://doi.org/10.1023/A:1009874100973

ten Cate, O. (2005). Entrustability of professional activities and competency-based training. *Medical Education*, *39*(12), 1176–1177.

ten Cate O. (2021). Health profession education scholarship: The emergence, current status, and future of a discipline in its own right. *FASEB BioAdvances, 3*(7), 510–522. https://doi.org/10.1096/fba.2021-00011

ten Cate, O. T. J., Kusurkar, R. A., & Williams, G. C. (2011). How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE Guide No. 59. *Medical Teacher*, *33*(12), 961–973. https://doi.org/10.3109/0142159x.2011.595435

Chew, S. L., & Cerbin, W. J. (2021). The cognitive challenges of effective teaching. *Journal of Economic Education*, *52*(1), 17–40. https://doi.org/10.1080/00220485.2020.1845266

Christakis, N. A. (1995). The similarity and frequency of proposals to reform US medical education: Constant concerns. *Journal of the American Medical Association*, *274*(9), 706–711. https://doi.org/10.1001/jama.274.9.706

Colvin Clark, R., & Mayer, R. E. (2016). *e-Learning and the Science of Instruction – Proven Guidelines for Consumers and Designers of Multimedia Learning* (1st ed.). John Wiley & Sons, Inc.

Cooke, M., Irby, D., O'Brien, B. C., & Dooley-Hash, S. (2010). Educating Physicians: A Call for Reform of Medical School and Residency. *JAMA*, *304*(11), 1240–1241.

Cruess, R. L., Cruess, S. R., Boudreau, J. D., Snell, L., & Steinert, Y. (2014). Reframing medical education to support professional identity formation. *Academic Medicine*, *89*(11), 1446–1451. https://doi.org/10.1097/ACM.0000000000000427

Cruess, S. R., & Cruess, R. L. (1997). Professionalism must be taught. *British Medical Journal*, *315*(7123), 1674–1677. https://doi.org/10.1136/bmj.315.7123.1674

Custers, E. J. F. M. (2010). Commentary: Flexner and Dutch medical education: A misinterpretation? *Academic Medicine*, *85*(11), 1672–1674. https://doi.org/10.1097/ACM.0b013e3181f5cdb9

Davis, M. H., Karunathilake, I., & Harden, R. M. (2005). The development and role of departments of medical education. AMEE Education Guide no. 28. *Medical Teacher*, *27*(8), 665–675. https://doi.org/10.1080/01421590500398788

van Dijk, E., van Tartwijk, J., van der Schaaf, M., & Kluijtmans, M. (2020). What Makes an Expert University Teacher? A Systematic Review and Synthesis of Frameworks for Teacher Expertise in Higher Education. *Educational Research Review*, *31*, 100365.

Dyrbye, L.N., Thomas, M.R., & Shanafelt, T.D. (2005). Medical student distress: Causes, consequences, and proposed solutions. *Mayo Clinic Proceedings*, *80*(12), 1613–1622. https://doi.org/10.4065/80.12.1613

Elstein, A., Shulman, L., & Sprafka, S. (1978). *Medical Problem Solving. An Analysis of Clinical Reasoning*. Harvard University Press.

Eron, L.D. (1955). Effect of Medical Education on Medical Students' Attitudes. *Journal of Medical Education*, *30*(10), 559–566.

Eva, K.W., Rosenfeld, J., Reiter, H.I., & Norman, G.R. (2004). An admissions OSCE: The multiple mini-interview. *Medical Education*, *38*(3), 314–326. https://doi.org/10.1046/j.1365-2923.2004.01776.x

Flexner, A. (1910). *Medical education in the United States and Canada: a report to the Carnegie Foundation for the Advancement of Teaching*.

Frank, J., & Jabbour, M. (1996). *Skills for the new millennium: report of the societal needs working group – CanMEDS 2000 Project. Royal College of Physicians and Surgeons of Canada, Ottawa, ON, Canada*.

Frenk, J., Chen, L., Bhutta, Z.A., Cohen, J., Crisp, N., Evans, T., Fineberg, H., Garcia, P., Ke, Y., Kelley, P., Kistnasamy, B., Meleis, A., Naylor, D., Pablos-Mendez, A., Reddy, S., Scrimshaw, S., Sepulveda, J., Serwadda, D., & Zurayk, H. (2010). Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *The Lancet*, *376*(9756), 1923–1958. https://doi.org/10.1016/S0140-6736(10)61854-5

Glassick, C.E. (2000). Boyer's Expanded Definitions of Scholarship, the Standards for Assessing Scholarship, and the Elusiveness of the Scholarship of Teaching. *Academic Medicine*, *75*(9), 877–880.

Hafferty, F.W., & Franks, R. (1994). The Hidden Curriculum, Ethics Teaching, and the Structure of Medical Education. *Academic Medicine*, *69*(11), 861–871.

Hammond, K., Kern, F., Crow, W., Githens, J., Groesbeck, B., Gyr, J., & Saunders, L. (1959). *Teaching Comprehensive Medical Care*. Harvard University Press.

Hanson, L., & Talley, R. (1992). South Dakota's Third-Year Program of Integrated Clerkships in Ambulatory-care Settings. *Academic Medicine*, *67*(12), 817–819.

Harden, R.M., Crosby, J.R., Davis, M.H., & Friedman, M. (1999). Outcome-based education: Part 5 – From competency to meta-competency: a model for the specification of learning outcomes. AMEE Guide No. 14. *Medical Teacher*, *21*(6), 546–552. https://doi.org/10.1080/01421599978951

Harden, R.M.G., Downie, W.W., Stevenson, M., & Wilson, G.M. (1975). Assessment of Clinical Competence using Objective Structured Examination. *British Medical Journal*, *1*(5955), 447–451. https://doi.org/10.1136/bmj.1.5955.447

Hodges, B. D., Ginsburg, S., Cruess, R., Cruess, S., Delport, R., Hafferty, F., Ho, M.-J., Holmboe, E., Holtman, M., Ohbu, S., Rees, C., ten Cate, O., Tsugawa, Y., van Mook, W., Wass, V., Wilkinson, T., & Wade, W. (2011). Assessment of professionalism: Recommendations from the Ottawa 2010 Conference. *Medical Teacher*, *33*(5), 354–363. https://doi.org/10.3109/0142159X.2011.577300

Hornsey, M. J. (2008). Social Identity Theory and Self-categorization Theory: A Historical Review. *Social and Personality Psychology Compass*, *2*(1), 204–222. https://doi.org/10.1111/j.1751-9004.2007.00066.x

Ioannidis, J. P. A. (2017). The reproducibility wars: Successful, unsuccessful, uninterpretable, exact, conceptual, triangulated, contested replication. *Clinical Chemistry*, *63*(5), 943–945. https://doi.org/10.1373/clinchem.2017.271965

Irby, D. M., Cooke, M., & Brien, B. C. O. (2010). Calls for Reform of Medical Education by the Carnegie Foundation for the Advancement of Teaching: 1910 and 2010. *Academic Medicine*, *85*(2), 220–227.

Irby, D. M., Cooke, M., Lowenstein, D., & Richards, B. (2004). The Academy Movement: A Structural Approach to Reinvigorating the Educational Mission. *Academic Medicine*, *79*(8), 729–736. https://doi.org/10.1097/00001888-200408000-00003

Irby, D. M., & O'Sullivan, P. S. (2018). Developing and rewarding teachers as educators and scholars: remarkable progress and daunting challenges. *Medical Education*, *52*(1), 58–67. https://doi.org/10.1111/medu.13379

Irby, D. M., Ramsey, P. G., Gillmore, G., & Schaad, D. (1991). Characteristics of effective clinical teachers of ambulatory care medicine. *Academic Medicine*, *66*(1), 54–55.

Issenberg, S. B., McGaghie, W. C., Hart, I. R., Mayer, J. W., Felner, J. M., Petrusa, E. R., Waugh, R. A., Brown, D. D., Safford, R. R., Gessner, I. H., Gordon, D. L., & Ewy, G. A. (1999). Simulation Technology for Health Care Professional Skills Training and Assessment. *JAMA*, *282*(9), 861–866. https://doi.org/10.1001/jama.282.9.861

Jaarsma, D., Scherpbier, A., van der Vleuten, C., & ten Cate, O. (2013). Stimulating medical education research in the Netherlands. *Medical Teacher*, *35*(4), 277–281. https://doi.org/10.3109/0142159x.2012.749344

Jason, H. (2018). Celebrating 40 years of Medical Teacher : As the "last man standing" I look back to help us look forward. *Medical Teacher*, *40*(4), 331–336. https://doi.org/10.1080/0142159X.2018.1425383

Kennedy, T. J. T., & Lingard, L. A. (2006). Making sense of grounded theory in medical education. *Medical Education*, *40*(2), 101–108. https://doi.org/10.1111/j.1365-2929.2005.02378.x

de Landesheere, G. (1985). History of Educational Research. In T. Husen & T. N. Postlethwaite (Eds.), *The International Encyclopedia of Education Research and Studies* (pp. 1588–1596). Pergamon Press.

Lindeboom, G. A. (1968). Herman Boerhaave (1668-1738). Teacher of All Europe. *JAMA*, *206*(10), 2279–2301.

Lingard, L. (2016). Paradoxical Truths and Persistent Myths. *Journal of Continuing Education in the Health Professions*, *36*(1), pp. 19–21. https://doi.org/10.1097/CEH.0000000000000078

Loyens, S.M.M., Kirschner, P.A., & Paas, F. (2012). Problem-based learning. In K.R. Harris, T.S. Graham, A.G. Urdan, A. Bus, S. Major, & H.L. Swanson (Eds.), *APA handbooks in psychology®. APA educational psychology handbook. Application to learning and teaching.* (Vol. 3, pp. 403–425). American Psychological Association.

Ludmerer, K.M. (1985). *Learning to Heal. The development of American medical education*. The Johns Hopkins University Press.

Ludmerer, K.M. (1999). *Time to Heal* (1st ed.). Oxford University Press.

Lyons, A.S., & Petrucelli, R.J. (1987). *Medicine. An Illustrated History*. Harry N. Abrams Inc.

Maggio, L.A., Costello, J.A., Norton, C., Driessen, E.W., & Artino, A.R. (2021). Knowledge syntheses in medical education: A bibliometric analysis. *Perspectives on Medical Education*, *10*(2), 79–87. https://doi.org/10.1007/s40037-020-00626-9

McGaghie, W., Miller, G., Sajid, A., & Telder, T. (1978). *Competency-based Curriculum Development in Medical Education – An Introduction*. World Health Organization.

van Merriënboer, J.J.G. (n.d.). *Goodbye and Hello from your Research Director*. Maastricht SHE Newsletter September 2020. Retrieved 20 October 2020, from https://www.maastrichtuniversity.nl/news-events/newsletters/article/deNVKfY2Ufgdo1CMgQd0aA

Merton, R., Reader, G., & Kendall, P. (Eds.). (1957). *The Student Physician. Introductory Studies in the Sociology of Medical Education*. Harvard University Press.

Miller, G.E. (1970). A Perspective on Research in Medical Education. *Journal of Medical Education*, *45*(9), 694–699.

Norcini, J., Blank, L., Arnold, G., & Kimball, H. (1995). The Mini-CEX (clinical evaluation exercise): A preliminary investigation. *Annals of Internal Medicine*, *123*(10), 795–799.

Norman, G.R., & Schmidt, H.G. (1992). The psychological basis of problem-based learning: A review of the evidence. *Academic Medicine*, *67*(9), 557–565.

Norman, G. (2003). RCT = results confounded and trivial: The perils of grand educational experiments. *Medical Education*, *37*(7), 582–584. https://doi.org/10.1046/j.1365-2923.2003.01586.x

Norman, G. (2011). Fifty years of medical education research: Waves of migration. *Medical Education*, *45*(8), 785–791. https://doi.org/10.1111/j.1365-2923.2010.03921.x

Norman, G. (2018). May: a month of myths. *Advances in Health Sciences Education*, *23*(3), 449–453. https://doi.org/10.1007/s10459-018-9836-z

Norman, G.R., Tugwell, P., Feightner, J., Muzzin, L., & Jacoby, L. (1985). Knowledge and clinical problem-solving. *Medical Education*, *19*(5), 344–356.

O'Brien, B.C., Irby, D.M., Durning, S.J., Hamstra, S.J., Hu, W.C.Y., Gruppen, L.D., & Varpio, L. (2019). Boyer and Beyond: An Interview Study of Health Professions Education Scholarship Units in the United States and a Synthetic Framework for Scholarship at the Unit Level. *Academic Medicine*, *94*(6), 893–901. https://doi.org/10.1097/ACM.0000000000002625

O'Brien, B., Forrest, K., Wijnen-Meijer, M., & ten Cate, O. (2019). A global view of structures and trends in medical education. In T. Swanwick, K. Forrest, & B.C. O'Brien (Eds.), *Understanding Medical Education* (3rd ed., pp. 7–22). Wiley-Blackwell.

Paton, M., Kuper, A., Paradis, E., Feilchenfeld, Z., & Whitehead, C.R. (2020). Tackling the void: the importance of addressing absences in the field of health professions education research. *Advances in Health Sciences Education*, *26*(1), 5–18. https://doi.org/10.1007/s10459-020-09966-x

Poncelet, A., & Hirsh, D. (Eds.). (2016). *Longitudinal Integrated Clerkships. Principles, Outcomes, Practical Tools, and Future Directions*. Gegensatz Press and Alliance for Clinical Education.

Reeves, S., Goldman, J., Freeth, D., & Zwarenstein, M. (2013). Interprofessional Education: Effects on professional practice and healthcare outcomes. *The Cochrane Database of Systematic Reviews*, *3*, 1–47. https://doi.org/10.1002/14651858.CD002213.pub3.www.cochranelibrary.com

Regehr, G. (2010). It's NOT rocket science: rethinking our metaphors for research in health professions education. *Medical Education*, *44*(1), 31–39. https://doi.org/10.1111/j.1365-2923.2009.03418.x

Rizwan, M., Rosson, N.J., Tackett, S., & Hassoun, H.T. (2018). Globalization of Medical Education: Current Trends and Opportunities for Medical Students. *Journal of Medical Education and Training*, *2*(1), 035.

Rotgans, J.I. (2012). The themes, institutions, and people of medical education research 1988-2010: Content analysis of abstracts from six journals. *Advances in Health Sciences Education*, *17*(4), 515–527. https://doi.org/10.1007/s10459-011-9328-x

Sawyer, R.K. (2006). The New Science of Learning. In R.K. Sawyer (Ed.), *The Cambridge Handbook of The Learning Sciences* (1st ed., pp. 1–16). Cambridge University Press.

Schmidt, H.G., & Mamede, S. (2020). How cognitive psychology changed the face of medical education research. *Advances in Health Sciences Education*, *25*(5), 1025–1043. https://doi.org/10.1007/s10459-020-10011-0

Schumacher, D.J., Dornoff, E., Carraccio, C., Busari, J., van der Vleuten, C., Kinnear, B., Kelleher, M., Sall, D.R., Warm, E., Martini, A., & Holmboe, E. (2020). The Power of Contribution and Attribution in Assessing Educational Outcomes for Individuals, Teams, and Programs. *Academic Medicine*, *95*(7), 1014–1019. https://doi.org/10.1097/acm.0000000000003121

Schunk, D.H. (2012). *Learning Theories – an Educational Perspective* (6th ed.). Pearson Education, Inc.

Skeff, K., Campbell, M., Stratos, G., Jones, H., & Cooke, M. (1984). Assessment by Attending Physicians of a Seminar Method to Improve Clinical Teaching. *Journal of Medical Education*, *59*(12), 944–950.

Steinert, Y. (2000). Faculty development in the new millennium: Key challenges and future directions. *Medical Teacher*, *22*(1), 44–50. https://doi.org/10.1080/01421590078814

Tekian, A. (2014). Doctoral programs in health professions education. *Medical Teacher*, *36*(1), 73–81. https://doi.org/10.3109/0142159X.2013.847913

Tekian, A., & Harris, I. (2012). Preparing health professions education leaders worldwide: A description of masters-level programs. *Medical Teacher*, *34*(1), 52–58. https://doi.org/10.3109/0142159X.2011.599895

Teunissen, P.W., & Westerman, M. (2011). Junior doctors caught in the clash: The transition from learning to working explored. *Medical Education*, *45*(10), 968–970. https://doi.org/10.1111/j.1365-2923.2011.04052.x

Thompson-Burdine, J., Thorne, S., & Sandhu, G. (2021). Interpretive Description: A flexible qualitative methodology for medical education research. *Medical Education*, *55*(3), 336–343. https://doi.org/10.1111/MEDU.14380

Touchie, C., & ten Cate, O. (2016). The promise, perils, problems and progress of competency-based medical education. *Medical Education*, *50*(1), 93–100.

Turner, J. (1982). Towards a cognitive redefinition of the social group. In H. Tajfel (Ed.), *Social Identity and Intergroup Relations* (pp. 15–40). Cambridge University Press.

UMC Utrecht – UCSF Doctoral Program In Health Professions Education PhD Candidate Guide. University of California San Francisco School of Medicine Center for Faculty Educators. Retrieved 20 October 2020, from https://meded.ucsf.edu/faculty-educators/faculty-development/advanced-education-programs/doctoral-program-health-professions-education/umc-utrecht-ucsf-doctoral-program-health-professions-education-phd-candidate-guide

Varpio, L., Gruppen, L., Hu, W., O'Brien, B., Ten Cate, O., Humphrey-Murto, S., Irby, D.M., van der Vleuten, C., Hamstra, S.J. & Durning, S.J. (2017). Working definitions of the roles and an organizational structure in health professions education scholarship: Initiating an international conversation. *Academic Medicine*, *92*(2), 205–208. https://doi.org/10.1097/ACM.0000000000001367

Varpio, L., O'Brien, B., Hu, W., ten Cate, O., Durning, S.J., van der Vleuten, C., Gruppen, L., Irby, D., Humphrey-Murto, S., & Hamstra, S.J. (2017). Exploring the institutional logics of health professions education scholarship units. *Medical Education*, *51*(7), 755–767. https://doi.org/10.1111/medu.13334

Verwijnen, M., Imbos, T., Snellen, H., Stalenhoef, B., Pollemans, M., van Luijk, S., Sprooten, M., van Leeuwen, Y., & van der Vleuten, C. (1982). The Evaluation System at the Medical School of Maastricht. *Assessment & Evaluation in Higher Education*, *7*(3), 225–244.

van der Vleuten, C. P. M., & Schuwirth, L. W. T. (2005). Assessing professional competence: From methods to programmes. *Medical Education*, *39*(3), 309–317. https://doi.org/10.1111/j.1365-2929.2005.02094.x

Wachter, R. (2015). *The Digital Doctor. Hope, Hype, and Harm, at the Dawn of Medicine's Computer Age.* McGraw-Hill.

Wijesooriya, N. R., Mishra, V., Brand, P. L. P., & Rubin, B. K. (2020). COVID-19 and telehealth, education, and research adaptations. *Paediatric Respiratory Reviews*, *35*, 38–42. https://doi.org/10.1016/j.prrv.2020.06.009

Williams, G. (1980). *Western Reserve's Experiment in Medical Education and Its Outcome.* Oxford University Press.

Wojtczak, A. (2013). *AMEE Occasional Paper 5: History of AMEE 1972-2009*. Association for Medical Education in Europe. https://amee.org/getattachment/what-is-amee/History_AMEE_CD_AUG2013.pdf

Woolliscroft, J. O. (2020). *Implementing Biomedical Innovations into Health Education, and Practice. Preparing Tomorrow's Physicians*. Academic Press/Elsevier.

Ziv, A., Small, S. D., & Wolpe, P. R. (2000). Patient safety and simulation-based medical education. *Medical Teacher*, *22*(5), 489–495. https://doi.org/10.1080/01421590050110777

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Do face-to-face panel interviews in medical school admission help us select empathetic students? Results of a cross-sectional study

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Empathy is a key attribute of competent physicians. Yet, research on empathy as medical school admission criterion in Germany is still scarce. Lübeck Medical School admits 60 percent of students via standardised, structured face-to-face panel interviews designed to measure non-academic aspects of aptitude for medical school. We hypothesise that we can detect a difference in empathy levels between interview-admitted and non-admitted students. In our sample (N = 420), admitted compared to non-admitted applicants show significantly higher empathy scores on an established standardised self-assessment tool. The effect persists when relevant covariates (age, sex and pre-university grade point average) are included in the analysis. Of the covariates, only sex had a significant influence. Despite limited generalisability, our study indicates that interviews do help select empathetic medical students and contributes to the field of medical school admission research with implications for practice.

1 Introduction

Medical school admission in Germany is highly competitive as the number of applications is some four times larger than study place capacities (SFH, 2019). Given this scarcity on the one hand, and the societal demand for medical doctors on the other, selection becomes inevitable in medical school admission and should focus on an applicant's aptitude for a successful course of study and the medical profession.

The necessity to emphasise interpersonal skills development throughout medical school and residency makes an assessment of candidates' non-cognitive attributes a feasible approach in order to select suitable candidates with the highest potential to become competent physicians (Hojat, 2014). Among desirable non-cognitive traits and qualities, empathy has recently become a focus of interest in teaching, training and admission. Empathy facilitates informative patient-physician communication (Coulehan et al., 2001; Neumann et al., 2012) and can ultimately lead to better physical and psychosocial health outcomes for patients (Elliott et al., 2018; Hojat et al., 2011; Neumann et al., 2012) as well as higher patient satisfaction (Menendez et al., 2015; Wang et al., 2018; Zachariae et al., 2003).

With regard to student selection for medical school admission, we expect candidates who show a high level of empathy at admission to have an advantage in their further empathy development during medical teaching and training. Hojat (2014) argues in favour of selecting applicants with an existing empathic orientation over those who need additional intensive training from a cost-effectiveness perspective. Some studies show a decline in empathy scores during medical training (for details see section 2). Yet, the decline was less steep in those with initially higher empathy scores (Chen et al., 2012). However, empathy has been studied only sparingly in the context of the German medical school admission system and results are insufficient to confidently introduce measures of empathy (Knorr et al., 2018; Obst et al., 2016).

We undertook our investigation at Lübeck Medical School (LMS), where since 2012 approximately 60% of medical students have been admitted via a school-specific selection procedure (*Auswahlverfahren der Hochschulen*) that, at its core, relies on face-to-face panel interviews. The previous interest had been whether personality and psychometric inventories could be utilised for our selection procedure (Kötter et al., 2017; Obst et al., 2016). Naturally, we are also interested in the effectiveness of the panel interview itself to detect empathetic students. Assuming that panel interviews are a capable instrument to ascertain a candidate's aptitude, we hypothesise that we can detect a difference in empathy levels between interview-admitted and non-admitted students. As the admission decision is a result of a candidate's overall interview score, it is conceivable that suitable candidates with high overall interview scores possess other desirable traits and qualities – such as empathy – detectable in the panel interview. Alternatively, certain domains that are explicitly addressed in the panel interview may be interrelated with empathy.

In this paper, we first outline the importance of empathy in the clinical context, followed by an overview of the German admission system and the specificities of the LMS selection procedure in sections 2 and 3. Section 4 describes the study design, methods and analyses. Results are presented and discussed in sections 5 and 6. The final section summarises implications for research and practice.

2 Empathy in the clinical context

Empathy is one of the key attributes of competent physicians. In a clinical context, empathy involves understanding a patient's situation, perspective and feelings, communicating this understanding and acting accordingly in a therapeutically helpful way (Mercer & Reynolds, 2002). Being able to understand and reflect another person's thoughts and emotions facilitates fruitful physician-patient communication and improved patient outcomes (Banja, 2006; Kerasidou & Horn, 2016; Zachariae et al., 2003). Consequently, empathy has seen an increased relevance in medical training

and a variety of measures strengthening students' and residents' empathy has been introduced in recent years. International examples of medical education frameworks, such as the CanMeds Framework (Frank, 2005) and the Accreditation Council for Graduate Medical Education Outcome Project (Swing, 2007), emphasise on the relevance of interpersonal and communication skills. The *Master Plan for Medical Studies 2020 (Masterplan Medizinstudium 2020)* is a similar transformation currently underway in Germany (BMBF, 2017).

Nonetheless, conceptualising empathy is not easy as definitions and aspects of dimensionality vary. In general, concepts largely concur that empathy involves a cognitive component (Davis, 1980; Dohrenwend, 2018; Hojat et al., 2001; Mercer & Reynolds, 2002), while some authors additionally emphasise the emotional facet (Davis, 1980) or moral and behavioural aspects (Mercer & Reynolds, 2002). Hemmerdinger et al. define empathy as "*a personality trait that enables one to identify with another's situation, thoughts, or condition by placing oneself in their situation"* (2007, p. 2). Universally and regardless of the age group studied or measure utilised, empathy in females has been shown to exceed levels in males (Chen et al., 2012; Davis, 1980; Davis & Franzoi, 1991; Hojat et al., 2011).

Particularly in studies concerning empathy in medical students and medical education, self-reported measures are commonplace, among which the Interpersonal Reactivity Index (IRI) (Davis, 1983) and the Jefferson Scale of Empathy (JSE) (Hojat et al., 2001) are the most widely used. The JSE was developed to assess empathy specifically in healthcare providers and views empathy as an interpersonal skill relevant to the concept of clinical competence (Hojat et al., 2001). In contrast, the IRI was developed in a general population setting (Davis, 1983). Supporting the underlying assumption that empathy is a stable construct, Davis and Franzoi (1991) have shown maturity in trait empathy development that renders IRI scores stable in high-school students. Hojat et al. (2005) found a moderate statistically significant correlation in overall IRI and JSE scores ($r = .45$, $p < 0.01$). This empirical overlap supports that the scales measure different but related constructs. Ultimately, the research question and the target population should inform the choice of instrument (Hemmerdinger et al., 2007; Pedersen, 2009).

Results on the trajectories of medical students' empathy throughout the course of study are mixed. The most recent meta-analysis shows inconclusive results on empathy increase/decline with little effect on actual bedside behaviour (Ferreira-Valente et al., 2017). Particularly longitudinal studies show a decline of empathy scores on the JSE throughout the course of study with a significant drop upon entering the clinical phase (Ferreira-Valente et al., 2017; Hojat et al., 2009; Papageorgiou et al., 2019). A deterioration was observed in a systematic review that also included cross-sectional

studies (Neumann et al., 2011). Commonly, reasons for empathy decline are related to distress stemming from the "hidden/informal curriculum" (e. g. high work-load, time pressure, mistreatment by superiors, a shift away from humanistic aspects of care towards technology and objectivity, lacking role models) or negative learning experiences (West & Shanafelt, 2007). Paradoxically, more frequent patient contacts in the beginning of the clinical phase and the related confrontation with clinical reality have been found to diminish empathy (Hojat et al., 2009; Neumann et al., 2011). A qualitative study elicited additional reasons which negatively affect medical students' empathy such as individual patient characteristics, professional development and general doubts about the health care system (Pohontsch et al., 2018).

3 Admission to medical school in Germany: A national framework and local adaptations

3.1 Transition from predominantly cognitively-oriented to aptitude-related admission criteria

Until recently, negligible attention had been paid to non-cognitive attributes such as empathy in the selection of medical students in the German admissions system. On the contrary, an emphasis was put on cognitively-oriented measures, particularly on applicants' secondary school leaving grade (*Abitur*), hereafter referred to as pre-university grade point average (pu-GPA). As the average of two years of high school performance across a broad canon of subjects, pu-GPA is universally considered indicative of general cognitive functions and has demonstrated acceptable predictive validity for academic success in the pre-clinical phase of medical school (Kadmon et al., 2014; Patterson et al., 2016; Trapmann et al., 2007). The predominance of the pu-GPA becomes evident in that 20% of study places were allocated solely based on pu-GPA. It was also a secondary criterion in the 20% quota for applicants with accrued waiting time since high school graduation. For another 60% of study places, medical schools were at liberty to employ individual selection schemes, including criteria such as aptitude or knowledge tests, interviews, previous health-related vocational training and employment, or grades of individual subjects (e.g. biology, physics). Yet, pu-GPA had to be a deciding factor in this quota and, for some individual medical schools, was lawfully used as the sole criterion (for an overview see Schwibbe et al., 2018). Besides pu-GPA, aptitude or knowledge tests, namely the German Test for Medical Studies (TMS) and the Hamburg Natural Science Test (Ham-Nat) have been broadly applied in the admission process across medical schools in Germany (for an overview see Schwibbe et al., 2018). Both tests have demonstrated predictive validity regarding academic success during the pre-clinical stage (Kadmon & Kadmon, 2016; Werwick et al., 2018). One major disadvantage, however, is their limited value in predicting students' academic performance in the clinical phase and clinically relevant practical skills (Saguil et al., 2015; Sladek et al., 2016).

Thanks to a ruling by the German Constitutional Court in 2017, which declared parts of the German admissions system for medical studies unconstitutional, the system has undergone major changes, including the reshaping of the admission quotas and the reconfiguration of admission criteria (Bundesverfassungsgericht, 2017). Overall, a shift can be observed towards criteria that are better predictors of an applicant's aptitude during preclinical and clinical phases as well as the actual medical profession. While the pu-GPA quota is augmented to 30%, the selection quota now requires at least two additional criteria alongside pu-GPA. The former waiting time is fully replaced by a 10% quota for candidates selected without any grade-based criteria (Staatsvertrag, 2019). This overhaul opens up a window of opportunity for the introduction of more diverse selection methods aimed at non-cognitive traits, such as interview formats of varying degrees of standardisation and structure.

Interviews in general are a nationally and internationally widely accepted selection instrument that aims to measure non-academic competencies crucial in competent physicians (Patterson et al., 2016; Schwibbe et al., 2018). Typical formats in student selection are panel interviews and multiple mini-interviews (MMI). While in panel interviews multiple raters simultaneously assess aspects of a candidate's strengths, weaknesses and overall aptitude, MMIs follow a multiple sample approach in which a number of raters evaluate candidates in various interview stations (Eva et al., 2004). Patterson et al. (2016) point out consistent findings of predictive validity evidence for MMIs. Likewise, in panel interviews, higher degrees of structure and competence-based assessment are associated with improved reliability and prognostic validity (Albanese et al., 2003; Huffcutt et al., 2013; Levashina et al., 2014; Patterson et al., 2016). Particularly for panel interviews, countermeasures addressing potential weaknesses such as social desirability effects or rater bias are well established (Cook, 2016).

3.2 University-specific selection at LMS via panel interviews

The selection procedure focuses on capturing non-academic competencies and communication skills and balancing those with indicators of academic performance in school (Brüheim et al., 2012). The initial goal was to identify applicants whose aptitudes, inclinations and interests align best with our school's profile and values while succeeding academically with regard to study progress and exam success. Selected students performed well (Mommert et al., 2020) and many of them anecdotally attributed being highly motivated to the positive experience of having been selected.

In a pre-interview stage, a bonus system awards deductions off the pu-GPA for criteria such as TMS scores, completed health-related vocational training and extracurricular activities. Invitations to face-to-face panel interviews are extended to the 240 highest-ranking applicants. Interviewees are randomly assigned to one of twelve

three-person mixed-gender panels consisting of two faculty members and one student. All panel members receive instructions to utilise biographical and situational question techniques, as those are less prone to influences from social desirability and impression management (Barrick et al., 2009; Levashina et al., 2014). Particularly, new panel members participate in an interview training that provides theoretical background on sources of bias and rating errors and familiarises them with interview techniques and the instruments used. A fully standardised, competence-based score sheet has been specifically developed at LMS. The score sheet encompasses five primary domains, namely motivation, knowledge about the course of study, social engagement, (self-) reflection and communication. In addition, an interview guide gives a brief description of desirable manifestations of each primary domain and example questions for each score sheet item. While the 30-minute-interviews are semi-structured to give panel members the opportunity to probe interviewees' statements, their reasoning and rationales, the assessment is fully structured. Interviewers individually rate each of the five items per domain on a five-point verbally and numerically anchored rating scale ranging from 0 (not at all) to 4 (entirely) resulting in a maximum of 100. Inter-rater reliability is routinely assessed as part of the quality assurance system using intraclass correlation coefficients (ICC). For the two cohorts, overall inter-rater reliability was excellent with values of $ICC\ (1,3)_{2018} = .92$ and $ICC\ (1,3)_{2019} = .90$. The post-interview score sums interview and pu-GPA scores. Interview scores are calculated as the mean of the independent panel members' ratings, then adjusted for the overall strictness or leniency of the panel and finally fit to a 0 to 30 range via linear transformation. Pu-GPA is transformed to a score on a 31-point-scale with a deduction of one point for every tenth off the maximum pu-GPA (range: 1.0 (best) to 4.0 (worst)). About half of the interviewees with the highest-ranking post-interview scores are admitted.

4 Study design

Our study investigates whether there are differences in empathy levels in admitted and non-admitted interviewees of the 2018 and 2019 LMS selection procedure ($n_{2018} = 226$; $n_{2019} = 228$). All were asked to participate in a post-interview evaluation and quality assurance survey. Additionally, we asked them to anonymously and voluntarily fill out the questionnaire for this study. Participating interviewees were given written information detailing the purpose of data collection and data handling. The information also contained an explicit statement that participation in the evaluation or the study would not influence selection. A numerical alias allowed linkage of the study questionnaire (dependent measure) and procedural data such as sex, age, pu-GPA, interview score and admission status. To ensure privacy, an in-house data custodian conducted this linkage. The local ethics committee approved this procedure in both years (references 18-213 and 19-257).

4.1 Dependent measure: empathy

As we were interested in empathy as a personality trait rather than a goal of professional development, for the purpose of this study, we adopt the conceptualisation of empathy as a personality trait and therefore stable construct in accordance with Hemmerdinger et al. (2007). Hence, to test our hypothesis that differences in empathy scores between admitted and non-admitted interviewees exist, we used the German 16-item short form version of the IRI, called *Saarbrücker Persönlichkeitsfragebogen (SPF-IRI)* as a measurement of empathy (Paulus, 2009). The SPF-IRI had already been employed in the context of the LMS selection procedure (Obst et al., 2016). The reported reliability (α = .78) of the SPF-IRI is comparable to the original IRI (Davis, 1980; Paulus, 2009). It contains the original four subscales:

1. *perspective taking (PT)*: assessment of one's tendency to spontaneously adopt the perspective or point of view of others
2. *fantasy (FS)*: assessment of one's tendency to identify and empathise with fictitious characters in books or movies
3. *empathic concern (EC)*: assessment of one's tendency to experience "other-oriented" emotional reactions (e.g. compassion, concern, pity) witnessing others in distress
4. *personal distress (PD)*: assessment of one's tendency to experience "self-oriented" emotional reactions (e.g. anxiety, discomfort, uneasiness) when witnessing others in distress or in tense and close interpersonal settings

Items are answered on a five-point Likert scale ranging from 1 (never applicable) to 5 (always applicable) in reference to the item statement. To compute an overall empathy score, only the EC, FS and PT subscale scores were added as suggested by Paulus (2012).

4.2 Statistical analysis, independent measures and covariates

For descriptive analyses, means (*M*) and standard deviations (*SD*) were calculated for all continuous variables; two-tailed t-tests were used for comparisons. For dichotomous items, data were analysed using χ^2-tests (Fisher's exact test); relative frequencies (%) are presented. Scale reliability was assessed computing Cronbach's α. We used a 5%-significance level for all analyses. We first conducted analysis of variance (ANOVA) with admission status as the independent and the SPF-IRI score as the dependent measure. Second, in analysis of covariance (ANCOVA) sex, age and pu-GPA were introduced as covariates. Adjusted means (M_{adj}) and corresponding standard errors (*SE*) were obtained. Effect sizes were quantified as (partial) η^2.

5 Results

Of the 454 interviewees, 420 (92.51%; n_{2018} = 212; n_{2019} = 208) participated in our study and filled out the SPF-IRI. Participants from 2018 and 2019 did not differ regarding participation rate, sex distribution, mean age, pu-GPAs, interview and empathy scores (all *p*s ≥ .147).

Overall, participants were predominantly female (74.52%). The mean age was 20.49 years (*SD* = 2.13) and mean pu-GPA was 1.47 (*SD* = .22). Characteristics of admitted and non-admitted participants are displayed in Table 1. Both sex ratio and mean age were comparable in admitted and non-admitted groups (*p*s ≥ .50). The mean pu-GPA was slightly more favourable among admitted interviewees. Expectedly, mean interview scores differed significantly. Reliability of the SPF-IRI empathy scale was good (α = .76).

Table 1: Interviewee characteristics by admission status

	N	admitted	non-admitted	χ^2 (1, 420)	*p*
sex, % female	420	72.99	76.08	.53	.502
				t (418)	
age *M (SD)*	420	20.44 (2.00)	20.53 (2.25)	.37	.698
pu-GPA *M (SD)*	420	1.44 (.22)	1.50 (.22)	2.68	.008
interview score *M (SD)*	420	21.44 (4.14)	11.06 (4.77)	23.81	.000

pu-GPA: pre-university grade point average; range: 1.0 (best) to 4.0 (worst).

Regarding our main hypothesis, we found a statistically significant difference in empathy scores between admitted and non-admitted participants in the one-way ANOVA (see Table 2). Empathy scores were significantly higher in admitted compared to non-admitted participants. The difference in mean empathy scores of 1.43 translates to a small effect size (η^2 = .02). When age, sex and pu-GPA were included as covariates, both the significant effect and the effect size persisted in the ANCOVA. Of the three covariates, only sex turned out to be significant: female participants (*M* = 46.16, *SD* = 5.01) displayed higher empathy scores than male participants (*M* = 44.62, *SD* = 4.81).

Table 2: ANOVA and ANCOVA results on empathy by admission status (N = 420)

	admission status				
	admitted *M (SD)*	non-admitted *M (SD)*	*F* (1, 418)	*p*	η^2
empathy	46.48 (4.90)	45.05 (5.02)	8.69	.003	.02
	admitted M_{adj} *(SE)*	*non-admitted* M_{adj} *(SE)*	*F* (1, 415)	*p*	η^2
empathy	46.48 (.34)	45.05 (.34)	8.67	.003	.02
sex			8.04	.005	.02
age			.63	.426	.00
pu-GPA			.21	.647	.00

empathy: computed overall empathy score (Paulus, 2012).
pu-GPA: pre-university grade point average.

6 Discussion, conclusions and implications

Face-to-face panel interviews at LMS are designed to measure specific non-academic aspects of aptitude for medical school. The intention of this study was to examine whether we can also detect a difference in empathy levels between interview-admitted and non-admitted students. For this purpose, analyses of (co)variance were performed comparing empathy scores of admitted and non-admitted interviewees. Our results demonstrate that interviewees who were admitted via face-to-face panel interviews at LMS indeed showed higher empathy scores than their non-admitted counterparts. The magnitude of the effect was small. Even when we controlled for relevant covariates, such as participants' sex, age and pu-GPA, higher empathy scores among selected individuals persisted. Among the independent variables, only being female was independently associated with higher empathy scores.

6.1 Main finding: differences in empathy between admitted and non-admitted applicants

Our results are in line with our hypothesis in that selected interviewees indeed showed higher empathy scores than non-admitted interviewees. The effect size was small, comparable to the magnitude of the difference between females and males (η^2 = .02, respectively). We are, however, confident in the robustness of our findings. We used a rather large sample consisting of interviewees from two consecutive cohorts and the effect and magnitude of the effect persisted even when covariates were included in the analysis as statistical controls. At this stage of the investigation, it is unclear how interviewees' empathy measured by the SPF-IRI translates to higher scores

awarded by the panel members in the face-to-face panel interviews that ultimately lead to admission. We will discuss two possible mechanisms in detail.

First, as the admission decision is a function of an applicant's overall aptitude as a medical student, suitable candidates may possess other desirable non-cognitive traits and qualities, even when those are not explicitly focused on. Specifically, interviewees with a higher sum score across our five primary domains may be more empathetic as well. In this case, we would assume that empathy is a rather implicitly measured cross-sectional trait. A somewhat comparable result was obtained in a study by Heintze et al. (2004) examining the feasibility of alternative selection instruments for dentistry studies. They found a relationship between candidates' self-rated social competence and a more positive interview result ($r = 0.24$, $p < 0.05$). The study did not report a correlation coefficient for interview results and the applied two IRI scales (EC and PT), yet concluded that social abilities could certainly be assessed in interview situations. In a Swedish qualitative study that aimed to generate an impression of panel members' perspectives on the admission procedure, the author elicited that, in the semi-structured interviews, panel members *"look for such attributes as realism, motivation, maturity, attitudes, endurance, drive, engagement, empathy, i.e. non-cognitive attributes"* (Röding, 2005, p. 121). What is more, results from an MMI reliability study call into question raters' capability to score candidates accurately across desired non-cognitive traits. To an extent, the interviewers may have applied a broader, unidimensional construct, such as overall suitability for medical school (Sebok et al., 2014). It is possible that some of our constructs and empathy are intertwined enough for empathy scores to implicitly influence interview scores.

Potentially, empathy may be related to aspects that we explicitly address in the face-to-face panel interviews. From internal quality assessments, we know that admitted and non-admitted interviewees most strongly differ in the social engagement dimension. Our findings could be reasonably interpreted as a reflection of some of the traits and qualities that are explicitly measured in this dimension of the interview. It seems likely that the more empathetic someone is, the more she or he will engage socially. More empathetic interviewees will more easily be able to give biographical examples of their social engagement. Thus, the social engagement dimension of the interview does indirectly address empathy. Service or co-curricular activities, just like social engagement, also enrich personal development in students (Brazeau et al., 2011; Huang & Chang, 2004). The interest and responsiveness to learn from others and to reflect on those experiences is thereby fostered, which ultimately may lead to higher affective and cognitive empathy (Huang & Chang, 2004). As such, participation in service and social engagement activities prior to entering higher education could be beneficial in the development of empathy as well.

6.2 Covariate findings: sex, age and pu-GPA

Of the three covariates, only sex had an independent effect on empathy scores; female interviewees scored higher on empathy. This result is in accordance with the extensive body of literature that invariably points towards higher levels of empathy in females (Chen et al., 2012; Davis, 1980; Davis & Franzoi, 1991; Hojat et al., 2011). Reasons suggested for these differences may be evolutionary and associated with more prosocial behaviour as well as better emotion recognition and management (Christov-Moore et al., 2014) and/or may be a function of variations in communication skills (Graf et al., 2017). However, this effect does not influence our main finding since female and male interviewees were admitted in the same proportions. Additionally, controlling for sex did not disperse the admission effect; neither did the adjusted mean empathy scores in the ANCOVA differ from means in the ANOVA, nor did the effect size (η^2 = .02, in ANOVA and ANCOVA) of the admission effect.

Conversely, age and pu-GPA had no significant effect in the ANCOVA. As for age, this finding is consistent with our assumption and most likely reflects maturity in trait empathy that renders IRI scores stable in high-school students, as shown by Davis and Franzoi (1991). Even though we did not expect an effect of pu-GPA on empathy scores, we included it as a covariate since the mean pu-GPA is slightly more favourable among those admitted, as presented in Table 1. This, however, is an artefact attributable to the Higher Education admissions law itself that mandates pu-GPAs have a significant influence in the admission decision (Hochschulzulassungsgesetz, 2016). As outlined, admission is based on the final summed score of the interview and pu-GPA scores. Interviewees who rely on multiple bonuses in pre-selection in order to gain access to an interview require relatively higher interview scores to compensate the offset from the bonuses. With regard to empathy, no influence was found in the ANCOVA.

6.3 Potential influences from faking goodness and social desirability effects

Faking goodness and portraying oneself as more favourable could pose a potential threat in high stakes selection situations. Both would endanger the procedure's validity and might entail negative implications for the selection decision itself whenever individuals attain preferential rank order positions regardless of their true aptitude. We consider the risk of faking or social desirability effects on empathy scores to be rather small in our study. For one, for all participants it was made clear in the instructions that participation in the study would not influence selection, and, therefore, we assume that participants saw little reason to falsify their responses. Second, findings by Paulus (2019) suggest that there is only little danger of impression management. A study on social desirability effects on three personality questionnaires (i.e. SPF-IRI, the

work-related stress and coping questionnaire AVEM, and the Big-Five-based personality questionnaire NEO-FFI) using a within-subjects design (Obst et al., 2016) also showed only weak evidence for faking effects. Even when study participants were prompted to fake, the overall difference in the SPF-IRI scores between the fake-good and control conditions was only on the verge of statistical significance (p = .05). Similarly, Ones and Viswesvaran (2011) concluded that social desirability effects are negligible in validity studies on Big-Five personality assessments. Finally, all of our participants found themselves in the same high stakes situation and thus would all be equally inclined to fake. The effect that we found using a between-subject design can, therefore, not be attributed to faking or social desirability effects.

6.4 Study limitations and further research

The findings of this study ought to be reflected in the light of its limitations and avenues for future research. One potential limitation concerns the choice of instrument to measure empathy in our study. We deliberately chose the IRI over the JSE because of the JSE's conspicuous wording. With items such as *"Willingness to imagine oneself in another person's place contributes to providing quality care"* (Hojat et al., 2001, p. 358), the construct of interest was, in our opinion, too easy to guess by the study participants posing a relevant risk of faking good. Even more importantly, we were interested in empathy as a personality trait rather than a clinical skill to be developed during medical studies, particularly with regard to the pre-medical education stage of our study participants. This said, we certainly agree, that empathic conduct in physician-patient encounters and in an interprofessional medical environment, of course, can be learned and developed and is a necessary component in teaching and training. At the same time, there is evidence of an association between empathy and burnout although causality and directionality data are inconsistent (Wilkinson et al., 2017). Thus, balancing empathy and professional distance is an equally important educational goal.

The specific nature of the LMS selection procedure poses a limitation as to the generalisability of the results to other medical schools in Germany or beyond. Overall, the effect size in the ANOVA was small, yet persisted when potentially confounding variables were included in the analysis. Our independent finding of female participants' higher level of empathy replicates a well-known effect and raises our confidence in our findings overall.

On our part, further research should focus on untangling the underlying mechanism of how interviewees' empathy translates to higher scores awarded by the panel members in the face-to-face panel interviews, which ultimately lead to better chances of admission. This includes but is not limited to further analyses of the SPF-IRI subscale scores rather than the overall score as well as correlation and regression analyses of

the primary interview domains and empathy (subscale) scores. The reliability of our interview procedure needs to be addressed as well. A revision of our primary domains or the interview score sheet may have to be considered. Moreover, we will investigate longitudinally whether empathy scores remain stable throughout medical education and whether empathy at selection predicts performance in clinically-relevant exam formats, such as Objective Standardized Clinical Examinations (OSCE), at later stages of medical training or other clinically relevant outcome parameters to further validate the selection procedure.

7 Conclusions

Our results have implications for practice, particularly as most medical schools face transformation in admissions mandated by the Ruling of the German Constitutional Court (Bundesverfassungsgericht, 2017) and in curriculum development requested by the *Master Plan for Medical Studies 2020* (BMBF, 2017*)*. These structural changes open up a window of opportunity to direct more research at a wider range of selection methods that assess non-academic competencies in order to assess applicants' aptitude to become competent physicians holistically. In that regard, this study contributes to the body of knowledge on admission procedures in general and in the German context specifically. It could be informative for medical schools facing these transformative processes.

With a shift in research focus in the past 15 years on highly standardised selection methods such as MMIs and their ability to identify favourable candidates, the investigation of panel interviews has receded. Patterson et al. (2016) have called the reliability and validity of "traditional interviews" into question; they concede, however, that the mixed findings in their systematic review most likely stem from a broad range in interview methodology. The authors advocate for the utilisation of MMIs and Situational Judgement Tests (SJT) instead. MMIs are indeed intriguing as they purport to objectify the measurement of non-cognitive traits and to reduce various forms of bias (Eva et al., 2004). In theory, for any given trait, such as communication, integrity or empathy, one or more stations may be developed which then produce accurate measures of that construct. Vice versa, one would not expect to find aspects of a certain construct when it has not been intentionally included. However, construct validity and dimensionality are oftentimes insufficient in MMIs (Patterson et al., 2016; Sebok et al., 2014). In Germany, SJTs that also purport to measure non-cognitive traits in a standardised and less costly manner compared to interviews (Patterson et al., 2016) are still in their infancy (Schwibbe et al., 2018). Compared to face-to-face panel interviews, which leave room to probing a candidate's response, merely choosing one from a set of listed responses in SJTs seems to create a low-fidelity atmosphere in a high stakes situation.

Most concerning, SJTs are potentially susceptible to social desirability effects and faking, thus jeopardising fairness and validity in admission (Peeters & Lievens, 2005).

The intention of this article was to investigate whether we could detect a difference in empathy levels between admitted and non-admitted students in the standardised and structured face-to-face panel interviews conducted at LMS. Our results suggest that using such interviews can indeed be helpful in selecting more empathetic interviewees into medical school. This selection effect persisted even when we controlled for interviewees' age, sex and pu-GPA and is unlikely to have been distorted by faking or social desirability effects. Our finding of higher empathy scores in female participants is in line with previous research. Latest findings on the LMS selection procedure are encouraging. A pilot study by Kötter et al. (2020) recently found that general practitioners rated the overall suitability to become a good doctor most favourably for students admitted via face-to-face panel interviews, while Mommert et al. (2020) compared academic outcomes at the first federal examination of various admission quotas, in which selected students displayed high temporal continuity and examination success. Taken together with the findings of this study, consistent research is emerging that suggests that standardised and structured face-to-face panel interviews are an effective selection method to discern aspects of an applicant's aptitude for medical studies and the medical profession after all – contrary to zeitgeist beliefs.

References

Albanese, M. A., Snow, M. H., Skochelak, S. E., Huggett, K. N., & Farrell, P. M. (2003). Assessing Personal Qualities in Medical School Admissions. *Academic Medicine*, *78*(3), 313–321.

Banja, J. D. (2006). Empathy in the physician's pain practice: Benefits, barriers, and recommendations. *Pain Medicine*, *7*(3), 265–275.

Barrick, M. R., Shaffer, J. A., & DeGrassi, S. W. (2009). What you see may not be what you get: Relationships among self-presentation tactics and ratings of interview and job performance. *Journal of Applied Psychology*, *94*(6), 1394–1411.

Brazeau, C. M. L. R., Schroeder, R., Rovi, S., & Boyd, L. (2011). Relationship Between Medical Student Service and Empathy. *Academic Medicine*, *86*(10), 42–45.

Brüheim, L., Sievers, K., & Westermann, J. (2012). Nicht allein die Abiturnote. *Forschung und Lehre*, *19*(11), 912–913.

Bundesministerium für Bildung und Forschung [BMBF]. (2017). *Beschlusstext „Masterplan Medizinstudium 2020"*. Retrieved on 5 September 2020 from https://www.bmbf.de/files/2017-03-31_Masterplan%20Beschlusstext.pdf.

Bundesverfassungsgericht. (2017). *Judgment of the First Senate of 19 December 2017 - 1 BvL 3/14 - paras. (1–253)*. Retrieved on 5 September 2020 from http://www.bverfg.de/e/ls20171219_1bvl000314en.html.

Chen, D. C. R., Kirshenbaum, D. S., Yan, J., Kirshenbaum, E., & Aseltine, R. H. (2012). Characterizing changes in student empathy throughout medical school. *Medical Teacher*, *34*(4), 305–311.

Christov-Moore, L., Simpson, E. A., Coudé, G., Grigaityte, K., Iacoboni, M., & Ferrari, P. F. (2014). Empathy: Gender effects in brain and behavior. *Neuroscience and Biobehavioral Reviews*, *46*(4), 604–627.

Cook, M. (2016). *Personnel selection: Adding value through people – a changing picture* (6th ed.). Chichester: Wiley-Blackwell.

Coulehan, J. L., Platt, F. W., Egener, B., Frankel, R., Lin, C.-T., Lown, B., & Salazar, W. H. (2001). "Let Me See If I Have This Right …": Words That Help Build Empathy. *Annals of Internal Medicine*, *135*(3), 221.

Davis, M. H. (1980). A Multidimensional Approach to Individual Differences in Empathy. *JSAS Catalog of Selected Documents in Psychology*, *10*, 85. Retrieved on 5 September 2020 from https://www.uv.es/~friasnav/Davis_1980.pdf.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, *44*(1), 113–126.

Davis, M. H., & Franzoi, S. L. (1991). Stability and change in adolescent self-consciousness and empathy. *Journal of Research in Personality*, *25*(1), 70–87.

Dohrenwend, A. M. (2018). Defining Empathy to Better Teach, Measure, and Understand Its Impact. *Academic Medicine*, *93*(12), 1754–1756.

Elliott, R., Bohart, A. C., Watson, J. C., & Murphy, D. (2018). Therapist empathy and client outcome: An updated meta-analysis. *Psychotherapy*, *55*(4), 399–410.

Eva, K. W., Rosenfeld, J., Reiter, H. I., & Norman, G. R. (2004). An admissions OSCE: The multiple mini-interview. *Medical Education*, *38*(3), 314–326.

Ferreira-Valente, A., Monteiro, J. S., Barbosa, R. M., Salgueira, A., Costa, P., & Costa, M. J. (2017). Clarifying changes in student empathy throughout medical school: A scoping review. *Advances in Health Sciences Education*, *22*(5), 1293–1313.

Frank, J. R. (ed.). (2005). *Better standards. Better physicians. Better care. Ottawa: The Royal College of Physicians and Surgeons of Canada*. Retrieved on 5 September 2020 from http://www.ub.edu/medicina_unitateducaciomedica/documentos/CanMeds.pdf.

Graf, J., Smolka, R., Simoes, E., Zipfel, S., Junne, F., Holderried, F., Wosnik, A., Doherty, A. M., Menzel, K., & Herrmann-Werner, A. (2017). Communication skills of medical students during the OSCE: Gender-specific differences in a longitudinal trend study. *BMC Medical Education, 17*(1), 75.

Heintze, U., Radeborg, K., Bengtsson, H., & Stenlåås, A. (2004). Assessment and evaluation of individual prerequisites for dental education. *European Journal of Dental Education*, *8*(4), 152–160.

Hemmerdinger, J. M., Stoddart, S. D. R., & Lilford, R. J. (2007). A systematic review of tests of empathy in medicine. *BMC Medical Education*, *7*(1), 24.

Hochschulzulassungsgesetz. (2016). *Landesvorschriften und Landesrechtsprechung*. Retrieved on 5 September 2020 from http://www.gesetze-rechtsprechung.sh.juris.de/jportal/portal/t/ki3/page/bsshoprod.psml?pid=Dokumentanzeige&showdoccase=1&js_peid=Trefferliste&fromdoctodoc=yes&doc.id=jlr-HZGSH2016rahmen&doc.part=X&doc.price=0.0&doc.hl=0#focuspoint.

Hojat, M. (2014). Assessments of empathy in medical school admissions: What additional evidence is needed? *International Journal of Medical Education*, *5*, 7–10.

Hojat, M., Louis, D. Z., Markham, F. W., Wender, R., Rabinowitz, C., & Gonnella, J. S. (2011). Physicians' empathy and clinical outcomes for diabetic patients. *Academic Medicine*, *86*(3), 359–364.

Hojat, M., Mangione, S., Kane, G. C., & Gonnella, J. S. (2005). Relationships between scores of the Jefferson Scale of Physician Empathy (JSPE) and the Interpersonal Reactivity Index (IRI). *Medical Teacher*, *27*(7), 625–628.

Hojat, M., Mangione, S., Nasca, T. J., Cohen, M. J. M., Gonnella, J. S., Erdmann, J. B., Veloski, J., & Magee, M. (2001). The Jefferson Scale of Physician Empathy: Development and Preliminary Psychometric Data. *Educational and Psychological Measurement*, *61*(2), 349–365.

Hojat, M., Vergare, M. J., Maxwell, K., Brainard, G., Herrine, S. K., Isenberg, G. A., Veloski, J., & Gonnella, J. S. (2009). The devil is in the third year: A longitudinal study of erosion of empathy in medical school. *Academic Medicine*, *84*(9), 1182–1191.

Huang, Y.-R., & Chang, S.-M. (2004). Academic and Cocurricular Involvement: Their Relationship and the Best Combinations for Student Growth. *Journal of College Student Development*, *45*(4), 391–406.

Huffcutt, A. I., Culbertson, S. S., & Weyhrauch, W. S. (2013). Employment Interview Reliability: New meta-analytic estimates by structure and format. *International Journal of Selection and Assessment*, *21*(3), 264–276.

Kadmon, G., & Kadmon, M. (2016). Academic Performance of Students with the Highest and Mediocre School-leaving Grades: Does the Aptitude Test for Medical Studies (TMS) Balance Their Prognoses? *GMS Journal for Medical Education*, *33*(1), 7.

Kadmon, G., Resch, F., Duelli, R., & Kadmon, M. (2014). Predictive Value of the School-leaving Grade and Prognosis of Different Admission Groups for Academic Performance and Continuity in the Medical Course – a Longitudinal Study. *GMS Journal for Medical Education, 31*(2), 21.

Kerasidou, A., & Horn, R. (2016). Making space for empathy: Supporting doctors in the emotional labour of clinical care. *BMC Medical Ethics*, *17*(1), 8.

Knorr, M., Schwibbe, A., Ehrhardt, M., Lackamp, J., Zimmermann, S., & Hampe, W. (2018). Validity evidence for the Hamburg multiple mini-interview. *BMC Medical Education*, *18*(1), 106.

Kötter, T., Obst, K., Brüheim, L., Eisemann, N., Voltmer, E., & Katalinic, A. (2017). Können psychometrische Tests den Erfolg im Auswahlgespräch zum Medizinstudium vorhersagen? Eine Querschnittsstudie an einer deutschen Hochschule. *Das Gesundheitswesen*, *79*(07), e40–e47.

Kötter, T., Rose, S. I., Waldmann, A., & Steinhäuser, J. (2020). Do Medical Students in Their Fifth Year of Undergraduate Training Differ in Their Suitability to Become a 'Good Doctor' Depending on Their Admission Criteria? A Pilot Study. *Advances in Medical Education and Practice*, *11*, 109–112.

Levashina, J., Hartwell, C. J., Morgeson, F. P., & Campion, M. A. (2014). The Structured Employment Interview: Narrative and Quantitative Review of the Research Literature. *Personnel Psychology*, *67*(1), 241–293.

Menendez, M. E., Chen, N. C., Mudgal, C. S., Jupiter, J. B., & Ring, D. (2015). Physician Empathy as a Driver of Hand Surgery Patient Satisfaction. *The Journal of Hand Surgery*, *40*(9), 1860-1865.e2.

Mercer, S. W., & Reynolds, W. J. (2002). Empathy and quality of care. *The British Journal of General Practice*, *52*, 9–12.

Mommert, A., Wagner, J., Jünger, J., & Westermann, J. (2020). Exam performance of different admission quotas in the first part of the state examination in medicine: A cross-sectional study. *BMC Medical Education*, *20*(1), 169.

Neumann, M., Edelhäuser, F., Tauschel, D., Fischer, M. R., Wirtz, M., Woopen, C., Haramati, A., & Scheffer, C. (2011). Empathy Decline and Its Reasons: A Systematic Review of Studies with Medical Students and Residents. *Academic Medicine*, *86*(8), 996–1009.

Neumann, M., Scheffer, C., Tauschel, D., Lutz, G., Wirtz, M., & Edelhäuser, F. (2012). Physician empathy: Definition, outcome-relevance and its measurement in patient care and medical education. *GMS Journal for Medical Education*, *29*(1), 11.

Obst, K. U., Brüheim, L., Westermann, J., Katalinic, A., & Kötter, T. (2016). Are the results of questionnaires measuring non-cognitive characteristics during the selection procedure for medical school application biased by social desirability? *GMS Journal for Medical Education*, *33*(5), 75.

Ones, D. S., & Viswesvaran, C. (2011). The Effects of Social Desirability and Faking on Personality and Integrity Assessment for Personnel Selection. *Human Performance*, *11*(2–3), 245–269.

Papageorgiou, A., Miles, S., & Fromage, M. (2019). Does medical students' empathy change during their 5-year MBBS degree? *Education for Health*, *31*(3), 142–147.

Patterson, F., Knight, A., Dowell, J., Nicholson, S., Cousans, F., & Cleland, J. (2016). How effective are selection methods in medical education? A systematic review. *Medical Education*, *50*(1), 36–60.

Paulus, C. (2009). Der Saarbrücker Persönlichkeitsfragebogen SPF (IRI) zur Messung von Empathie: Psychometrische Evaluation der deutschen Version des Interpersonal Reactivity Index. *Universität des Saarlandes*. Retrieved on 5 September 2020 from http://bildungswissenschaften.uni-saarland.de/personal/paulus/empathy/SPF_Artikel.pdf.

Paulus, C. (2012). *Ist die Bildung eines Empathiescores in der deutschen Fassung des IRI sinnvoll? Universität des Saarlandes.* Retrieved on 5 September 2020 from https://publikationen.sulb.uni-saarland.de/bitstream/20.500.11880/23403/1/Empathiescore.pdf.

Paulus, C. (2019). Ist Empathie eine Lüge? Zur Frage der sozialen Erwünschtheit in der Empathiemessung. *Saarländische Universitäts- und Landesbibliothek*. Retrieved on 5 September 2020 from https://publikationen.sulb.uni-saarland.de/bitstream/20.500.11880/27668/1/Empathie%20und%20soziale%20Erw%C3%BCnschtheit.pdf.

Pedersen, R. (2009). Empirical research on empathy in medicine – A critical review. *Patient Education and Counseling*, *76*(3), 307–322.

Peeters, H., & Lievens, F. (2005). Situational Judgment Tests and their Predictiveness of College Students' Success: The Influence of Faking. *Educational and Psychological Measurement*, *65*(1), 70–89.

Pohontsch, N.J., Stark, A., Ehrhardt, M., Kötter, T., & Scherer, M. (2018). Influences on students' empathy in medical education: An exploratory interview study with medical students in their third and last year. *BMC Medical Education*, *18*(1), 231.

Röding, K. (2005). Perceptions of admission committee members: Some aspects on individual admission to dental education at Karolinska Institutet. *European Journal of Dental Education*, *9*(3), 115–122.

Saguil, A., Dong, T., Gingerich, R.J., Swygert, K., LaRochelle, J.S., Artino, A.R., Cruess, D.F., & Durning, S.J. (2015). Does the MCAT predict medical school and PGY-1 performance? *Military Medicine*, *180*(4), 4–11.

Schwibbe, A., Lackamp, J., Knorr, M., Hissbach, J., Kadmon, M., & Hampe, W. (2018). Medizinstudierendenauswahl in Deutschland: Messung kognitiver Fähigkeiten und psychosozialer Kompetenzen. *Bundesgesundheitsblatt*, *61*(2), 178–186.

Sebok, S.S., Luu, K., & Klinger, D.A. (2014). Psychometric properties of the multiple mini-interview used for medical admissions: Findings from generalizability and Rasch analyses. *Advances in Health Sciences Education*, *19*(1), 71–84.

Sladek, R.M., Bond, M.J., Frost, L.K., & Prior, K.N. (2016). Predicting success in medical school: A longitudinal study of common Australian student selection tools. *BMC Medical Education*, *16*(1), 187.

Staatsvertrag. (2019). *Staatsvertrag über die Hochschulzulassung*. Retrieved on 5 September 2020 from https://hochschulstart.de/fileadmin/downloads/gesetze/StV_2019.pdf.

Stiftung für Hochschulzulassung [SFH]. (2019). *Daten der bundesweit zulassungsbeschränkten Studiengänge an Hochschulen*. Retrieved on 16 March 2021 from https://hochschulstart.de/fileadmin/user_upload/bew_zv_ws19.pdf.

Swing, S.R. (2007). The ACGME outcome project: Retrospective and prospective. *Medical Teacher*, *29*(7), 648–654.

Trapmann, S., Hell, B., Weigand, S., & Schuler, H. (2007). Die Validität von Schulnoten zur Vorhersage des Studienerfolgs – Eine Metaanalyse. *Zeitschrift für Pädagogische Psychologie*, *21*(1), 11–27.

Wang, H., Kline, J.A., Jackson, B.E., Laureano-Phillips, J., Robinson, R.D., Cowden, C.D., d'Etienne, J.P., Arze, S.E., & Zenarosa, N.R. (2018). Association between emergency physician self-reported empathy and patient satisfaction. *PloS One*, *13*(9), e0204113.

Werwick, K., Winkler-Stuck, K., & Robra, B.-P. (2018). From HAM-Nat to the "Physikum" – Analysis of the study success parameters before and after the introduction of a science test in the approval procedure. *GMS Journal for Medical Education*, *35*(3), 30.

West, C.P., & Shanafelt, T.D. (2007). The influence of personal and environmental factors on professionalism in medical education. *BMC Medical Education*, *7*(1), 29.

Wilkinson, H., Whittington, R., Perry, L., & Eames, C. (2017). Examining the relationship between burnout and empathy in healthcare professionals: A systematic review. *Burnout Research*, *6*, 18–29.

Zachariae, R., Pedersen, C.G., Jensen, A.B., Ehrnrooth, E., Rossen, P.B., & von der Maase, H. (2003). Association of perceived physician communication style with patient satisfaction, distress, cancer-related self-efficacy, and perceived control over the disease. *British Journal of Cancer*, *88*(5), 658–665.

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An integrated formula for determining the admission capacity in medical studies in reference to patients

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For most university study programmes, the determination of admission capacity depends on the availability of teaching staff. Medical schools commonly verify this calculation by determining admission capacity based on patients. Since the latter usually yields a smaller value, it is then the deciding factor for the admissions procedure at German medical schools and its judicial review. The Hannover Medical School has a permanent working group dedicated to improving this procedure because the patients' participation in medical instruction is limited in its scope and availability and cannot be increased by mere actions taken by administrators. For these reasons, the determination of a patient-based admission capacity for a medical study programme must be as reliable as possible. This project report puts forth a proposal to improve the traditional procedure by considering patient-based teaching holistically.

1 Introduction

A central pillar of academic medical education is instruction using patients. This instruction takes place in Germany and most European countries at the advanced semester level after covering the basic principles of the natural sciences. Because German law mandates that medical schools at state universities must educate as many students as possible, the medical schools are obliged to allocate the maximum admission capacity for each study programme. The calculation of the admission capacity of a medical school is based on the available teaching staff and the number of patients treated during the previous year (Niedersächsisches Ministerium für Wissenschaft und Kultur, 2018). Usually, the patient-based capacity determination yields the smaller value and thus the admission capacity to be set.

Since the mid-1980s, a standard model consisting of three calculation steps has been defined for the patient-based capacity determination (Lohfert et al., 1986). The aim is to use the time expected in the next academic years during which patients are available for instruction to teach as many students as possible. To calculate this, the available time with patients is divided by the time needed with patients by one student during their medical studies.

First, the admission capacity is calculated using the number of inpatients treated in the year before. Along with the number of treatment days for these patients, this first formula includes only the number of curricular hours required by German law for bedside teaching and patient suitability for such instruction; it does not include any other teaching formats using patients that are required by the German Medical Licensing Act (Approbationsordnung für Ärzte/ÄApprO).

In a second step, the number of students to be admitted is defined using the number of outpatients treated in the previous year in relation to the number of bedside teaching hours and the suitability of the outpatients. Figure 1 shows the original formula for this. De facto, however, only its set result (one study place for 1,000 new outpatient admissions) is used. Only half of the maximum possible outpatient teaching capacity calculated in this manner is added to the calculated inpatient teaching capacity.

The third step of the calculation entails an addition of student admission spaces for instruction involving patients that is taught outside the main university hospital at external teaching hospitals or general practitioners. While a recommendation exists for how to handle this final step, medical schools do, in fact, follow highly different mathematical approaches which often do not follow the same logic as the first two steps of the calculation.

The formulas are presented in Figure 1. What makes the patient-based determination of capacity special are the connections it makes between the quantities set by the curriculum (hours of instruction: v, group size: p) and those factors determined by patients (probability of suitability: L, patient resilience: b, frequency of examination: H) and those by the institution (beds occupied during daytime: tbB, outpatient new admissions: NZ). German administrative courts generally do not question this approach even though the model assumes that each patient is essentially suitable for bedside teaching purposes in each clinical specialty regardless of sex or reason for hospital stay.

Figure 1: The three traditional calculation steps to determine the patient-based admission capacity for a medical study programme

(1) $$kAp_s := tbB \bullet \frac{L_s \bullet b_s \bullet 24}{(v \bullet 12)/p}$$

(2) $$kAp_a := NZ \bullet \frac{L_a \bullet H_a \bullet (24/48)/A_a}{(v \bullet 12)/p}$$

$$kAp_a := \frac{\mathrm{NZ}}{1000} \div (kAp_s \bullet 0{,}5)$$

(3) $$kAp_e := (kAp_s + kAp_a) \bullet \frac{CAp_e}{CAp}$$

Whereby

Supply		**Demand**	
tbB	= beds occupied during daytime	n	= hours per week per semester
NZ	= outpatient new admissions	p	= number of students per patient
tpk	= outpatients per day	CAp	= proportion of curriculum with patient-based instruction
L	= probability of patients' suitability	$X_{s,\ ts,\ a}$	= inpatients, semi-inpatients, outpatients
b	= resilience of patients		
H	= frequency of examination	$X_{i,\ e}$	= internal, external
A	= number of patients per hour	**kAp**	**= clinical admission capacity**

Admittedly, it is only under certain conditions that this normative approach correctly reflects the actual bedside instruction given to medical students at a medical school. In particular, curricular models that provide for another mix of inpatients and outpatients can lead to distorted results (Fischer & Haller, 2010).

The formula also applies obsolete parameters and contains errors and breakdowns in logic (Lohfert, 2010). As these logical breakdowns and errors can affect the quality of education, this paper compares the standard model with an alternative mathematical model which is just as amenable to judicial review as the traditional one but which has only one formula, instead of three that are interpreted differently depending on the particular administrative court. The alternative mathematical model follows the same basic principle: The amount of patient time available is placed in relation to the necessary patient time needed to educate a student in order to calculate the maximum number of students to be educated.

2 The traditional way to determine the patient-related admission capacity

2.1 Legislative framework

Currently, the ÄApprO stipulates that during the third to fifth year of medical study 476 hours of instruction must be taught using patients (BMG, 2017). Half of this instruction should take place as patient demonstrations in groups of six and the other half as patient exams in groups of three. How many of these 476 hours must be taught using outpatients and how many using inpatients is left open by the ÄApprO.

Furthermore, students are required to complete block placements lasting between one and up to six weeks in surgery, internal medicine, paediatrics and gynaecology/obstetrics under the conditions imposed by the routine practice of clinical and outpatient care, and a block placement in general practice lasting at least two weeks. This aspect will be dramatically changed in 2025 when a newly revised ÄApprO will come into force (BMG & BMBF, 2017).

Separate from university study but still a pre-requisite to sit for the second part of the state medical exam between the fifth and sixth years of study, each student must demonstrate four months of clinical clerkships (*Famulatur*) at a freely chosen hospital or other medical facility providing outpatient care.

The entire sixth year of study is spent at the university hospital, an independent teaching hospital, or a teaching practice with a focus on patient-based instruction, whereby all students must complete four months each in surgery, internal medicine and an elective subject.

In addition to the learning of theory and the placements in the natural sciences and the theoretical clinical subjects, the patient-based instruction is meant to ensure the quality of the medical education. Even though the number of hours spent receiving bedside instruction is not high from the perspective of the individual student, particularly during the first five years of study, proper resource planning is of utmost importance. To illustrate this clearly, Table 1 shows the hours of patient-based teaching per student for bedside teaching and block placements juxtaposed against lectures. Moreover, the number of hours which must be offered by a medical school to educate a cohort of 330 students is also listed.

Table 1: Hours spent on patient-based teaching per individual student and student cohort

	per student			per cohort	
Curricular Parts	**hours**	**hours in % of the programme**	**group size**	**hours for 330 students**	**hours in % of the programme**
Lecture	1,624	29.1%	180	2,977	0.4%
Bedside Teaching (UaK)	476	8.5%	4	39,270	5.3%
Block Placements (BP)	280	5.0%	2	46,200	6.2%
Total	5,574	100.0%		744,927	100.0%

Of the four forms of patient-based instruction defined by the ÄApprO (UaK, BP, PJ, F), only the 476 hours of bedside teaching (UaK) are included in the patient-based capacity determination. The Capacity Regulations (Kapazitätsverordnung/KapVO) do not provide any further justification for why the determination of admission capacity is limited exclusively to this teaching format. In the case of the clinical clerkships, it can be argued that they are not formally part of the medical study programme and that they are usually completed outside of the university hospital. In terms of the education and learning which take place in the placement year, it can also be argued that this does not have to be completed at the university hospital, but rather could also be performed at an external teaching hospital.

However, there is no obvious justification for why the block placements cannot be included in the calculation of capacity. The number of hours to be taught may not be precisely defined, but perhaps even more than bedside teaching this form of patient-based teaching focuses on future medical practice in the healthcare system.

The traditional patient-based capacity determination must be urgently revised, not only because the new amendment of the ÄApprO (BMG & BMBF, 2017) is expected to expand teaching at external outpatient institutions and even stipulate instruction using simulated patients. For, unlike in the teacher-based capacity determination that is used for all university study programmes in Germany, a very important fact exists regarding medical study: The necessary time spent on patient-based instruction represents a voluntary contribution by patients which is offered free of charge. This resource should be used with care and in a targeted manner. In 2016, we formed the only research group on this topic in Germany to date because the traditional approach has logical inconsistencies that have been repeatedly litigated before the administrative courts.

2.2 Problems of the traditional approach

When implementing the required instruction hours in practice, the constraints related to this kind of teaching often represent large obstacles. The required group sizes can only be met if enough patients are willing to serve as demonstration or examination objects during instruction. This may not be the case because in the determination of capacity, no distinction is made between internal medicine patients, psychiatric patients, surgical patients or gynaecological patients. And even if, spread out over a calendar year, a sufficient number of otorhinolaryngology patients are suitable and willing to participate in teaching, this may by no means be the case during any given week of the semester. Such natural fluctuations can be accounted for in the curricular planning done by medical faculties. In addition, students can have a modifying effect through their individual areas of focus.

It is somewhat different with the standard requirements that stem from the Capacity Regulations (KapVO) and not the Medical Licensing Act (ÄApprO). The KapVO indirectly requires, via the formula system shown in Figure 1, that a third of patient-based teaching must take place using outpatients. Although the first empirical test of this standard rule at the national level for all 36 medical schools, performed by the firm Lohfert & Lohfert in 1986, showed that, in reality, the outpatient capacity was lower than the standard required by a factor of 10. A more recent empirical check by Lohfert & Lohfert for the Hannover Medical School (MHH) revealed that in 2010, the standard requirement still overestimated the real-world practicability by a factor of three (Lohfert & Lohfert, 2011).

The decision handed down by the Higher Administrative Court in Lüneburg, Germany, regarding the MHH variation of the traditional formula in Figure 1 also changed nothing about the standard requirements (OVG Lüneburg, 2016). The problem here is relatively easy to understand: Step 1 of the formula determines for which number of study spaces the usable patient-based teaching time can be exhausted using the inpatients. Step 2 determines the additional number of study spaces which can be created if outpatients are included in medical instruction. If this theoretically available outpatient-based teaching time cannot be used, whether due to organisational reasons or because the actual patients are more severely ill than the standard supposes, then the deficit in the needed patient-based teaching time must be compensated for by stronger inclusion of the inpatients. This represents, however, an adverse burden on individual inpatients and can be in violation of the ÄApprO, which states that unreasonable demands on patients in connection with teaching must be avoided (Section 2 subsection 3).

There are also problematic requirements in the third step of the patient-based capacity determination (Fischer, 2018). The interpretation, chosen by the administrative board

of the then central office for university admissions and presented in Figure 1, only uses mathematical parameters for teacher-based capacity determination. Together with the premise that basically each patient is interchangeable with every other patient for the purpose of medical instruction, this rule always results in an over-proportionate increase in the admission capacity when medical instruction is given at external healthcare institutions. If, for example, a medical school must hold instruction in gynaecology at an external institution because its own women's health clinic does not have a sufficient number of patients for instruction in gynaecology & obstetrics, then the medical school will not only have to admit more students and educate them in psychiatry and ophthalmology, but also in gynaecology, the very subject marked by the critical shortcoming that made outsourcing instruction necessary in the first place.

In addition to these weaknesses specific to single formulas, the traditional patient-based capacity determination has a whole series of weak points, the most obvious of which is the fact that the patient-determined quantities are based in part on standards from the 1970s and in part on empirical data from the mid-1980s. For even the obsolete differentiation between the different patient groups and the different time units in the determination of admission capacity using inpatients and outpatients could be corrected with a little good will (Fischer, 2012).

3 The integrated formula to determine the patient-related admission capacity

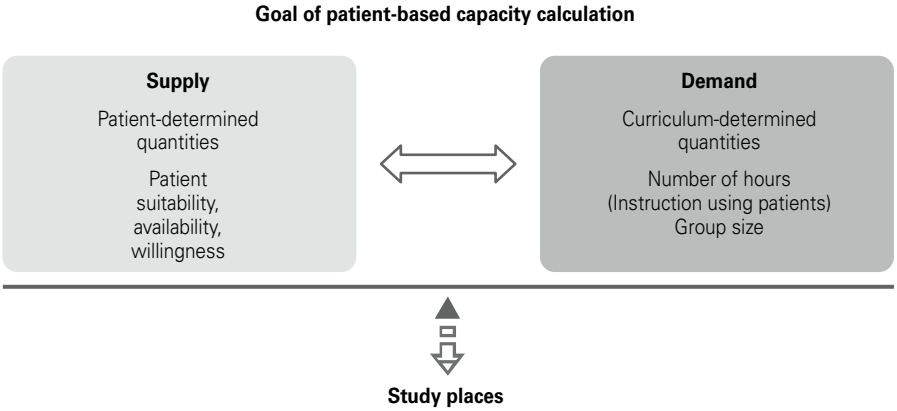
3.1 Basic principle

The task each determination of admission capacity for a university study programme needs to achieve is a balance between what can be supplied and the demand for resources to carry out the study programme. The result of these determinations is the number of admissible students in each academic year. These are the relevant resources for a medical study programme:

- Teaching staff and/or teaching load of the faculty members versus the demand for teaching time,
- The patients and/or the time with patients available for teaching versus the demand for time with patients, and
- Classroom spaces and/or spaces that can be used for teaching versus the demand for spaces.

The second aspect is the crucial factor for admission capacity at almost all German medical schools regarding the clinical phase of study. To determine this balanced state, a series of constraints must be taken into consideration, of which the most important ones for the patient-based capacity determination are given in Figure 2 below.

Figure 2: The basic principle of every patient-based determination of admission capacity



Only the current ÄApprO gives consideration to these constraints. The formulas set down in the KapVO, and presented in simplified form in Figure 1, for other constraining conditions do not, at present, necessarily result from the ÄApprO – the basis for quality assurance in university study. Although the formulas in the KapVO allow recognition of certain further-reaching ideas about quality assurance in medical education, these ideas have not yet been explicitly formulated. Added to this is that only parts of them can be derived from the ÄApprO. Likely not least due to its complexity, the traditional formula system was not adjusted in 2002 to accommodate the introduction of the block placements in the ÄApprO, although in these blocks differential diagnostics and the therapy of the most important clinical pictures are taught under the routine conditions of clinical and ambulant medicine, in what is clearly meant to be a patient-based education. With the next revision of the ÄApprO, additional patient-based teaching formats will be introduced and existing formats expanded to include other patient groups (BMG, 2020). As a consequence, even more problems with the traditional patient-based capacity determination will arise in the future. Such problems could be mitigated, if not avoided altogether, by following a different approach to the basic principle of patient-based determination of admission capacity (Fischer & Just, 2017).

3.2 The integrated formula

The traditional capacity determination calculates the number of entire study places separately for each type of patient treatment (inpatient, outpatient, or outside the university hospital). This subdivision corresponded feasibly with the billing method used in the 1980s. The fact that this took into consideration the length of treatment for these three patient groups according to the particular university hospital's billing system (days, written notes, none) also fits. Since 2003, there has been no example

curriculum prescribing in detail the number of hours for each clinical subject at all medical schools. For all that can be expected from the Master Plan for Medical Studies 2020 (BMG & BMBF, 2017) and the new amendment of the ÄApprO (BMG, 2020), the ÄApprO will continue to follow this approach.

It then stands to reason that the institution-based quantities contained in the traditional formula system should be combined into one formula. This offers a way to include patient groups that are currently still excluded, such as patients who receive inpatient care but are not admitted full-time, thereby falling into a category in-between inpatient and outpatient ("semi-inpatient"). By following this proposed strategy, the risk described above of overburdening individual patient groups could be avoided because no longer would each partial supply of patients be compared in relation to the full demand, but rather the full supply would be compared only once to the full demand.

If this new approach is applied to the still meaningful parameters of the current method, it quickly becomes clear that, although a university hospital can have data on the suitability of its own patients and their willingness to participate in teaching medical students, this information may not be available for external healthcare institutions or medical practices. It is not important here if the patient-determined quantities in Figure 1 involve 35- to 45-year-old parameters (Lohfert et al., 1986; Sachverständigengruppe, 1975), or if they are presently being updated as part of another project at individual university hospitals, or if the particular university hospital undertakes to do so at its own cost, as MHH did in 2009–2011 (Lohfert & Lohfert, 2011). By accepting admission to a medical school, students are committing to an entire course of study at a specific university. If a medical school then outsources patient-based teaching duties, it can very well be the case that the medical school will need to compensate the external teaching hospital for the use of its medical personnel for educational purposes and this must be taken into account in the teacher-based capacity determination. When calculating the patient-based capacity determination, however, the scarce resource in this context is the uncompensated time given by individual patients. How many patients a teaching hospital needs to treat so that 10 hours of instruction can be offered is of no significance to the medical school which has outsourced its teaching. The teaching hospital supplies 10 hours, the medical school demands 10 hours. All that needs to be shown in the formula is that the outsourced external hours may not be counted as part of the internal demand. Nevertheless, the admission capacity increases as a matter of course because there are fewer hours of patient-based teaching at the university hospital.

Figure 3: Conversion of outpatient new admission into contacts with outpatients per day

$$tpK := \frac{NZ \bullet H_a \bullet A_a}{365}$$

The units of time which are billed for inpatient, outpatient, and semi-inpatient care have to be brought into line with each other (Figure 3), the result is the integrated formula given in Figure 4. The complete derivation of this formula can be obtained from the authors.

Figure 4: Formula for integrated determination of the patient-based admission capacity

$$kAp := \frac{\left((tbB_s \bullet L_s \bullet b_s) + (tbB_{ts} \bullet L_{ts} \bullet b_{ts}) + (tpK \bullet L_a \bullet b_a\right)}{\left((V_s / p_s) + (V_{ts} / p_{ts}) + (V_a / p_a)\right)} + \frac{(V_e / p_e)}{(V_e / p_e)}$$

Simply as a result of viewing all patient groups together as a whole and taking any outsourced teaching regarding the same scarcity factor (patient time) into account, this uniform determination of a patient-based admission capacity avoids the major disadvantage of the traditional approach: That excessive demands are placed on inpatients when patient groups do not meet the standard size.

This critique of the current approach to determining capacity cannot be satisfactorily dealt with using the traditional formula system. The integrated formula proposed here reduces complexity without compromising differentiation. This is demonstrated in the following section for the bedside teaching (UaK).

3.3 Some exemplary calculations

Between 2013 and 2016, the MHH recorded an average of 1,129.74 daily occupied beds and 119,823.5 outpatient new admissions per year, or 1,050.51 outpatient contacts per day. If one compares both calculation methods for these patient data, one should distinguish different distributions of teaching hours among inpatients and outpatients. Although this does not play a role in the traditional formula, our alternative proposal does take this into account. Five exemplary hourly distributions for bedside teaching (UaK) in the first five years of study are presented in Table 2. Example I represents exactly the normative requirement for the bedside teaching as specified in the KapVO. Example II represents the ratio of bedside teaching with inpatients and outpatients reported by Lohfert & Lohfert (2011) without outsourcing; Example III has increased outpatient teaching compared to the normative setting, and Example IV simulates the MHH ratios with outsourced teaching in 2010. In Example V, bedside teaching is partially outsourced but is otherwise oriented towards the normative setting. In our view, however, only Examples II and IV reflect hourly distributions that can be found in reality.

The normative model calculates an inpatient admission capacity of 177.2 places plus 119.82 places based on the outpatients for all examples. Since the outpatient supple-

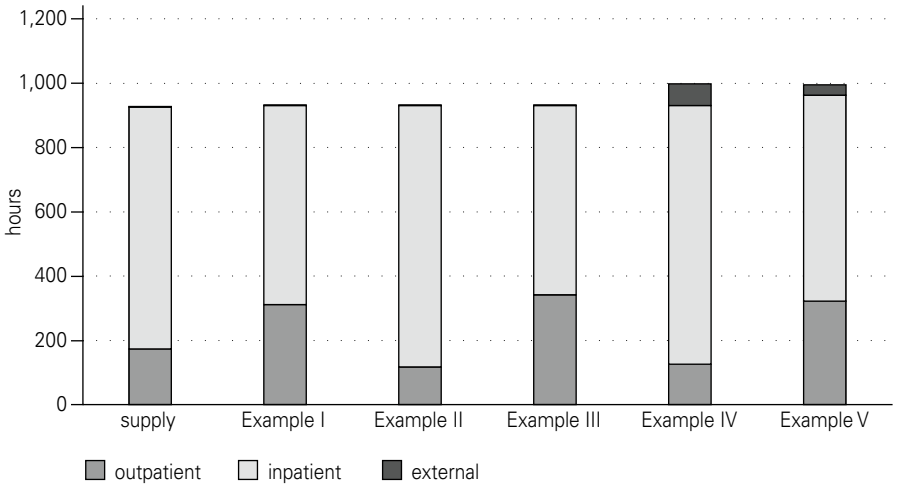
ment is capped at 50% of the inpatient capacity, the internal capacity in the normative model is 265.80 places. This is increased by 8.93 places for outsourced teaching in Examples IV and V.

Table 2: Distribution of patient-based teaching on different patient groups and the corresponding accommodation capacity

	Hours with			Capacity
Example	Inpatients	Outpatients	External patients	kApi
I	317	159	0	217.98
II	416	60	0	217.98
III	301	175	0	217.98
IV	400	60	16	225.56
V	301	159	16	225.56

The calculation results for our formula vary for inpatient capacity (kAps) and outpatient capacity (kApa). Since the number of teaching hours changes correspondingly within the examples, the joint internal capacity is 217.98 places (kApi). Only in Examples IV and V can 7.58 more students be accommodated because 16 hours were outsourced.

Figure 5: Comparison of supply and demand for patient time for bedside teaching in different patient groups.



A comparison of the patient time available for bedside teaching with the patient time demanded is not possible in the normative formula because the total number of hours is calculated for each part. The comparison of supply and demand determined within

our alternative approach is shown in Figure 5. It illustrates why our impression that only Examples II and IV would be encountered in reality corresponds with the assumption of the Higher Administrative Court in Lüneburg that a traditional calculation of the accommodation capacity might not be appropriate for avoiding the overuse of patient groups.

4 Conclusion

The relative proportion of instruction given using patients is not high from the perspective of an individual student, particularly during the first five years of study, if, as intended by the ÄApprO, the three-month nursing placement and the four-month clinical elective are not defined as part of the medical study programme. However, the tying up of the associated resources looks quite different from the perspective of the medical faculty and society, as the right column in Table 1 shows for different student cohort sizes. This is why the determination of admission capacity based on patients has such a large significance for medical study programmes.

Because the cost-free participation of patients in medical instruction is not available to an unlimited extent and cannot be increased by any action taken by administrators, the calculation of a patient-based admission capacity should be as reliable as possible for medical study without increasing the degree of complexity in the calculation. The integrated formula presented here uses the same parameters as the traditional separate formulas, such that it does not require any basic shift in thinking. Nevertheless, the integrated formula offers an opportunity to more flexibly respond to future differentiated educational concepts.

References

Bundesministerium für Gesundheit (BMG). (2017). *Approbationsordnung für Ärzte.* (BGBl. I S. 2581). Berlin: Bundesministerium für Gesundheit.

BMG. (2020). *Referentenentwurf der Verordnung zur Neuregelung der ärztlichen Ausbildung.* Berlin: Bundesministerium für Gesundheit.

BMG, & Bundesministerium für Bildung und Forschung (BMBF). (2017). *Masterplan Medizinstudium 2020.* Berlin. Retrieved from: https://www.bmbf.de/files/2017-03-31_Masterplan%20Beschlusstext.pdf

Fischer, V. (2012). Patienten, Ausbildungsstunden und Studienplätze. Ein Kommentar zu neuen, alten Unstimmigkeiten zwischen ÄAppO und KapVO. *Zeitschrift für Medizinische Ausbildung, 29*(1), Doc05.

Fischer, V. (2018). *Der externe Aufschlag in der patientenbezogenen Kapazitätsberechnung. Interpretative Varianten und ihre logische Schlüssigkeit.* Paper presented at the Jahrestagung der Gesellschaft für Medizinische Ausbildung, Wien.

Fischer, V., & Haller, H. (2010). *Erschweren die Approbationsordnung für Ärzte und die Kapazitätsverordnung die Planung einer patientenbezogenen Ausbildung?* Paper presented at the Jahrestagung der Gesellschaft für Medizinische Ausbildung, Bochum.

Fischer, V., & Just, I. (2017). *Angebot und Nachfrage als zwei Seiten der patientenbezogenen Kapazitätsberechnung.* Paper presented at the GMA-Jahrestagung, Münster.

Lohfert, C., Lohfert, P., & Muschter, W. (1986). *Überprüfung der Parameter der Kapazitätsverordnung zur Ermittlung der patientenbezogenen Aufnahmekapazität im stationären und ambulanten Bereich* (206). Kopenhagen, Hamburg.

Lohfert, P. (2010). *Spielt die Patientenverfügbarkeit für die Kapazitätsberechnung eine große Rolle?* Paper presented at the 71. ordentlicher Medizinischer Fakultätentag, Hannover.

Lohfert, P., & Lohfert, C. (2011). *Gutachten über die Kapazitätsberechnungsmethode für den Modellstudiengang HannibaL (UPPMK). Kurzfassung* (889). Kopenhagen.

Niedersächsisches Ministerium für Wissenschaft und Kultur. (2018). *Verordnung über die Kapazitätsermittlung zur Vergabe von Studienplätzen.* (Nds. GVBl. 13/2018, S. 209). Hannover. Retrieved from http://www.rechtsvorschriften-niedersachsen.de/gvbl/

OVG Lüneburg. (2016). *Beschluss zur Festsetzung der außerkapazitären Aufnahmekapazität im Studiengang Humanmedizin.* (2 NB 35/16 u. a.). Lüneburg: Oberverwaltungsgericht Lüneburg.

Sachverständigengruppe. (1975). *Abschließender Erfahrungsbericht der Sachverständigengruppe zum Vorlauf der Kapazitätsverordnung (KAPVO).* Zentralstelle zur Vergabe von Studienplätzen. Dortmund.

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Austria's struggle for an appropriate number of medical graduates

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At present, a number of Austrian stakeholders demand a further increase in study capacities and medical graduates in order to address a supposed shortage of physicians, following a supposed "glut" of physicians and a prediction of 20,000 unemployed MDs in the time before 2005. The claim of an impending deficit contrasts with the increasing number of MDs from about 20,000 in 1990 to about 45,000 MDs in 2019. This contribution argues that the perceived shortage is due to a number of inefficiencies in the Austrian health care sector rather than to the amount of medical students or graduates. These inefficiencies are also responsible for the comparative difficulties in retaining graduates trained in Austria and attracting medical professionals from other countries. Therefore, present challenges to the provision of medical care cannot be overcome by increasing numbers of graduates but require farsighted reforms to make the Austrian healthcare system fit for the future and attractive for young doctors.

1 Surplus or shortage? Numbers of graduates and physicians since 1945

In the 20th century, medicine in Austria was shaped by the expulsion of medical professionals in 1938 for anti-Semitic and political reasons (at the Medical Faculty of the University of Vienna, this affected more than half of the staff). An immediate consequence was a noticeable shortage of qualified doctors, although denazification was weakened by exceptional provisions, and doctors with a Nazi past could soon resume their work. On the whole, this led to a long lasting scientific narrowing and provincialisation of medicine in Austria. In the following decades, driven by open access to Austrian universities, the number of medical graduates and physicians rose significantly, from around 11,000 (1.6/1,000) in 1960 to around 30,000 (3.5/1,000) in the early 1990s (OECD, 2020). Before the introduction of an admission procedure according to EU law in 2006, there were around 20 times as many medical students in Vienna as at Harvard Medical School, with low graduation rates of 30 to 60 percent. From the 1980s on, the dominant narrative was that of a "glut of doctors" with unattractive job and salary prospects, and a forecast by the Österreichisches Bundesinstitut für Gesundheitswesen (Austrian Federal Institute for Health, ÖBIG) of 20,000 unemployed doctors by 2010 (Rehberger & Kerzner, 2015). In fact, Austria developed an above-average density of doctors with currently 5.2/1,000 (OECD average of 3.5; USA 2.6; OECD, 2019a; 2019b; 2020) and an annual graduate density of 14.4/100,000 (OECD average of 13.1/100,000; Switzerland 11.2; Germany 12.0; OECD, 2019a; 2019b; 2020). Cur-

rently, however, around 30 percent of all annual graduates consider leaving the country after completing their studies (Thaler et al., 2015). Consequently, the public narrative tipped over to that of "deficiency" around 2005, despite a continuously increasing number of doctors (Rehberger & Kerzner, 2015). A demand study by the ÖBIG (Czasný et al., 2012) predicted a shortage of doctors from 2025 on, also discussing the retirement of "baby boomer" doctors as an issue, even though the share of doctors above the age of 55 is 30 percent and thus below OECD average (34%, Germany 45%; OECD, 2020).

Summing up: If one follows the published opinion, the number of doctors in Austria in the last 70 years has never been "normal": The pendulum swung from "lack" after 1945 (less than 10,000 doctors) to "glut" after 1980 (approx. 20,000 doctors) and now again to "shortage" (currently approx. 45,000 doctors). To alleviate the perceived shortage, ÖBIG proposed several reforms of the Austrian health care system but did not recommend an increase in graduates. Notwithstanding, political representatives of regional health councils took the argument of a "lack of doctors" to advocate for an increase in medical graduates (a governour even spoke out in 2019 for "doubling" the number, (Österreichischer Rundfunk (ORF), 2019a)), as well as an increase in the number of undergraduate teaching sites. Little attention is paid in this discussion to the effects such measures would have on the quality of research, teaching and patient care at the medical universities and the international prestige of Austria as an academic hub in the context of international developments (Wissenschaftsrat, 2016). The political demand for quickly deployable workers for the local health system, ideally also for "Mangelfächer" (medical disciplines which face shortages of applicants), is primarily a quantitative one. The question remains: Which factors are therefore main drivers of the perceived shortage in graduates, and which contributions can be made from a university policy perspective to the improvement of the situation?

2 How to account for the discrepancy of a perceived lack and above average numbers of graduates and physicians

2.1 Hospital density

Austria stands out internationally not only because of its high density of graduates and doctors, but also because of its high density of hospitals and beds, with 7.3 beds per 1,000 inhabitants (OECD average 4.5; OECD, 2020), as well as length of stay and hospital frequency, with 256 per 1,000 inhabitants per year (EU average 173/1,000; OECD, 2019a). Even in light of increasing efforts to overcome partly redundant structures through regional and national "structural plans", the most massive obstacle is a pronounced fragmentation of the system between different sponsors and payers (Bachner et al., 2019; Hofmarcher, 2013). A hindrance in many regards are also deplor-

ably meager preventive efforts with 24.3 percent of the population consuming tobacco (OECD average 18%; OECD, 2020) and with 12.2 liters annual alcohol consumption (OECD average 8.8; OECD, 2020). The decades-long surplus ("glut") of poorly paid and inefficiently deployed medical doctors also had a problematic effect in the sense of a vicious circle: Due to an existing surplus of medical staff, health care facilities were not only established out of medical necessity, but also for purposes of local and protectionist labour market policies. Efficiency efforts such as the merging of medical care facilities usually failed, as was recently the case in Styria (in 2019). The dense hospital supply landscape has grown over time and continues to require high numbers of physicians.

2.2 Working hours

Until 2002, no Working Hours Act (KA-AZG) existed in Austria for doctors. Many structural deficits and inefficiencies were therefore disguised and mitigated by extremely long working hours and night shifts by the medical staff. Only in response to explicit criticism from the EU courts, a corresponding EU Directive was implemented nationally, with a maximum working time of 48 hours, and now, surprisingly, even more rigid than the EU would foresee, with the expiry of a personal "opt-out" option (Schütz, 2017). The newly implemented KA-AZG led to a union-won and, in view of the relatively low salaries of employed doctors in Austria, overdue increase in the real wages of the medical profession by around 30 percent (Schütz, 2017). However, the rigorous interpretation of the KA-AZG also led to a massive increase in workload density, decrease in medical training, discontinuous or redundant flow of information about patients and an expansion of the possibility of secondary employment outside of hospitals.

2.3 Insufficient division of labour

The current structure of Austrian health care is characterised by a relatively low number of nursing graduates (34.6/100,000 versus OECD average of 43.68; Germany 54.5; Switzerland 100.9; OECD, 2019a) and a below average number of practising nurses (6.9/1,000 versus OECD average of 8.8; Germany 12.9; Switzerland 17.2; OECD, 2019a). This results in a relatively low ratio of nurses to doctors and a lack of administrative staff. These factors are responsible for an unusually high number of inadequately deployed doctors. This situation, which has existed for many years, leads to a handicap in training and work overload, especially for younger doctors (Hofmarcher, 2013). An efficient, coordinated and harmonious architecture of the many and highly differentiated groups of "health care workers" employed in the healthcare system is an important long-term goal. Currently, the increasing professionalisation of non-medical "health care workers" is not sufficiently addressed, although recently, an

initial success was achieved by the implementation of the "jointly responsible area of activity" (Section 15 of the Health and Nursing Act) through the adoption of practical tasks by nursing staff that were previously reserved for doctors only.

2.4 Lack of international attractiveness

Despite many efforts, there are still serious structural deficits in the Austrian health care sector, particularly the integration of hospitals and private practices, but also fragmented financing structures and differences in care provision between urban and rural areas. The sum of all deficits leads to the situation that, according to graduate surveys, more than 30 percent of a medical graduation class do not aim for working in Austria after graduation due to the unattractive working conditions (Thaler et al., 2015). According to a 2015 study (Thaler et al., 2015), only a small proportion of German graduates remain in Austria, but over 80 percent of Austrian graduates. This finding is further underlined by the fact, that only about 5.8 percent of doctors trained abroad are currently working in Austria, but 34.1 percent in Switzerland and 17.7 percent in OECD countries (OECD, 2019b; 2020; Schütz, 2017). This trend would need change through extensive structural and quality measures attractive to Austrian and non-Austrian medical graduates alike. Given the present, albeit ineffective, care structure, the factors regional distribution, choice of disciplines, waves of retirement, effectiveness of care and emigration need to be considered (Britnell, 2019). Also, obsolete remuneration schemes for "supply-effective" medical services are not very helpful in international competition. For example, depending on the public care provider, a home visit to a patient is currently reimbursed with less than 100 EUR (ORF, 2018). Often driven by local interests and not primarily by the idea of international competition, Austria also faces poorly coordinated new foundations of small and semi-private university locations. Directly or indirectly, these schools are also operated by federal states, especially in their function as hospital and care providers. The hope, which has not yet materialised, that this will "bind" graduates to a particular location stands against a weakening of the academic standing.

2.5 Economisation, specialisation, inadequate effectiveness of care

Without doubt we currently witness a strong trend towards economisation of Medicine. This phenomenon leads to a more efficient resource allocation, but also favours the phenomenon of "cherry picking", i.e. the emphasis on economically attractive business models regardless of an actually required supply-effectiveness. The USA is an example of an increasing decoupling of the effectiveness of care and economic considerations, where a relatively high infant mortality and low life expectancy coincide with high health expenditures (Calderon, 2018). This "economic turn" is evident not only in the global migration of doctors (Hervey, 2017) and the primary choice of select

disciplines by young doctors, but also in the emergence of gaps in the care system for so-called "shortage disciplines" ("Mangelfächer"; Schütz, 2017). This de facto includes the entire pre-clinical area but also important disciplines such as child psychiatry, radiation therapy or, increasingly, general medicine. Another trend is the movement of entire subjects, such as forensic medicine, laboratory diagnostics or pathology to the private sector. In this respect, no general "lack of doctors" exists, but regional and selective deficits in defined disciplines.

In addition, despite a doubling of doctors in the last 20 years, the number of practices which accept patients with public health insurance, especially in general medicine, has remained constant, and is exceeded by elective "cash register" practices (without a health insurance contract and copayments for patients), which experience a boom, as well as private practices and private hospitals (ORF, 2019c). In 2018, there were 129 vacant positions for practices with public health insurance in Austria – including 68 positions for general practitioners and 61 specialist positions (Der Standard, 2019). The trend towards economisation and privatisation manifests itself not only in private or multi-class medicine. Increasingly and consequently, it also establishes itself in medical training institutions, especially private, "new" medical universities, which in some cases lack constitutive elements of traditional universities, but are economically profitable and provide a "second chance" for high school graduates who have not been able to get enrolled at a public university. Symptomatic for this context is the presentation of the chairman of the Austrian private university conference, who demanded that the internationally recognised public medical universities should primarily train students "from disadvantaged backgrounds" (Bayrhammer, 2016).

2.6 Delayed response to EU Membership 1995

Two delayed and ultimately non-EU-compliant procedures that would have enabled earlier adaptation to international standards played a decisive role. In addition to the delayed reaction to the EU Working Time Directive, it was common practice in Austria for 10 years to argue with the "country of origin principle", i.e. due to the unrestricted admission at Austrian universities, European high school graduates were allowed to study in Austria only if they were eligible in their home country. This practice was overturned by a judgement of the European Court of Justice in 2005 (Schütz, 2017). In consequence, an admission procedure was set up and study places were restricted (Schütz, 2017). According to an EU decision, 75 percent of the study places can be reserved for Austrian applicants, a quota that had to be dropped in 2019 for dental studies. The fact that some opinion leaders are still hesitant to accept the implications of the admission procedure required by EU law is underlined by the statement of a high-ranking chamber representative who says that "*... the test only filters out highly intelligent and critical persons who do not want to know anything about the periphery.*"

(ORF, 2019b). Whether such statements are suitable to bind young and apparently extremely committed colleagues to the Austrian workplace and to inspire them remains to be seen.

3 Conclusion: Most problems need to be addressed in the postgraduate sector, not within medical education

The history of and discussion about the density of medical graduates and doctors in Austria reflects well-known and widely discussed topics and structures in the Austrian healthcare landscape (Bachner et al., 2019; Hofmarcher, 2013; Schütz, 2017). In any case, the cause of regional and discipline-specific supply problems is not a too low number of graduates. The options to provide solutions from a university policy perspective are therefore limited. In view of an above average number of graduates, the request to make even more university training places available corresponds to an approach of "pouring more water into a bucket with a hole".

The above-mentioned discrepancies originate to a main extent in the postgraduate sector or reflect issues of international competitiveness of the health care sector and are not at the direct disposition of university policy. Austrian university hospitals face no shortage of qualified applicants and have already made major contributions to improve working conditions over the last years by increasing wages by approximately 30 percent or by moderately increasing the student intake. However, the attractiveness of the Austrian healthcare sector as a workplace is still in need of improvement. This is underlined by the fact that Austria only employs few doctors trained abroad and loses a substantial proportion of its graduates to neighbouring countries. This trend needs to be addressed through extensive structural and quality reforms and would be crucial to make the Austrian healthcare system fit for the future and attractive for young doctors.

References

Bachner, F., Bobek J., Habimana, K., Ladurner J., Lepuschütz., L, Ostermann, H., Rainer, L., Schmidt, A. E., Zuba, M., Quentin, W., & Winkelmann, J. (2019). Das österreichische Gesundheitssystem – Akteure, Daten, Analysen. *European observatory on health systems and policies, 20*(3), 1–288.

Bayrhammer B. (September, 2016). Durch Privatunis für Bedürftige Platz schaffen. *Die Presse*. Retrieved from https://www.diepresse.com/5111129/durch-privat-unis-platz-fur-bedurftige-schaffen/

Britnell, M. (2019). *Solving the global workforce crisis in healthcare*. Oxford University Press.

Calderon, A. (31 July, 2018). Why Americans Spend So Much on Health Care. *The Wall Street Journal*. Retrieved from https://www.wsj.com/articles/why-americans-spend-so-much-on-health-carein-12-charts-1533047243

Czasný, I., Hagleitner, J., Hlava, A., Sagerschnig, S., Stürzlinger, H., & Willinger, M. (2012). *Ärztinnen und Ärzte: Bedarf und Ausbildungsstellen 2010 bis 2030. Gesundheit Österreich. Im Auftrag des Bundesministeriums für Gesundheit und des Bundesministeriums für Wissenschaft und Forschung*. Retrieved from https://repository.publisso.de/resource/frl%3A4673990

Der Standard. (2019). *Immer mehr Wahlärzte, Kassenärzte stagnieren*. Retrieved from https://www.derstandard.at/story/2000097134595/immer-mehr-wahlaerzte-zahl-der-kassenaerzte- stagnates/

Hervey G. (2017). The EU exodus: When doctors and nurses follow the money. *Politico*. Retrieved from https://www.politico.eu/article/doctors-nurses-migration-health-care-crisis-workers-follow-the-money-european-commission-data/

Hofmarcher, M. (2013). *Das österreichische Gesundheitssystem – Akteure, Daten, Analysen*. Berlin: Medizinisch Wissenschaftliche Verlagsgesellschaft.

OECD. (2019a). *Health at a Glance 2019: OECD Indicators*. Paris: OECD Publishing. Retrieved from https://doi.org/10.1787/4dd50c09-en

OECD. (2019b). *Recent Trends in International Migration of Doctors, Nurses and Medical Students*. Paris: OECD Publishing. Retrieved from https://doi.org/10.1787/5571ef48-en

OECD. (2020). *Health Statistics 2020*. Retrieved from http://www.oecd.org/els/health-systems/health-statistics.htm

ORF. (2018). *Ärzte haben kaum Zeit für Hausbesuche*. Retrieved from https://wien.orf.at/v2/news/stories/2951520/

ORF. (2019a). *Mikl-Leitner fordert Verdoppelung der Medizin-Studienplätze*. Retrieved from https://orf.at/stories/3135079/

ORF. (2019b). *Ärztekammer gegen Medizin Aufnahmetest*. Retrieved from https://vorarlberg.orf.at/stories/3011819/

ORF. (2019c). *Wahlärzte-Boom: Neue Statistik bestätigt Trend*. Retrieved from https://orf.at/stories/3116534/

Rehberger, E.M., & Kerzner, M. (2015). Ärzteschwemme versus Ärztemangel in Österreich. Eine Analyse der medialen Öffentlichkeit der vergangenen 20 Jahre. *Soziale Sicherheit*, *5,* 215–223.

Schütz, W. (2017). *Eintritt nur nach Aufruf. Warum Österreich die Ärzte ausgehen: Elf Übel, elf Fakten*. Wien: Manz Verlag.

Thaler, B., Binder,. D., Mathä, P., & Unger, M. (2015). *Medizin-Absolventenmonitoring der Medizinischen Universitäten Wien und Graz. Arbeitsmarkteinstieg und regionaler*

Verbleib. Studie im Auftrag der Medizinischen Universitäten Wien und Graz. Wien: IHS.

Wissenschaftsrat. (2016). *Perspektiven der Universitätsmedizin*. Retrieved from https://www.wissenschaftsrat.de/download/archiv/5663-16.pdf

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Physicians as clinical teachers: Motivation and attitudes

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Especially in university hospitals, many physicians have to fulfil multiple roles as they treat patients, conduct research and act as clinical teachers. The present study focuses upon the latter role and analyses which attitudes and motivational patterns guide physicians in their teaching activities. With regard to motivation, we draw on self-determination theory and distinguish between autonomous and controlled motives. In terms of attitudes, we examine the extent to which clinical teachers use teaching activities that relate to a transmissive or constructivist paradigm. These questions are investigated using data from a questionnaire study conducted at a German university hospital. The respondents were 314 physicians who participated in one of two didactic qualification workshops at different points in their professional career. Physicians reported higher scores for autonomous types of motivation (derived from the self) than for controlled types (influenced by external factors). Further, we found that overall, the physicians considered both transmissive and constructivist concepts relevant for their teaching, but agreed even stronger to the constructivist paradigm. Latent class analyses revealed distinct patterns of attitudes towards teaching, but no relation between different motivations and teaching attitudes was found.

1 Introduction

Physicians work in a technology-rich, rapidly evolving context and require an array of diverse abilities, e.g. to be medical experts, versatile communicators, interprofessional collaborators, and proficient managers of healthcare (Frank & Danoff, 2007). Our study's emphasis is upon physicians' role as clinical teachers who instruct medical students (Busari et al., 2003; Steinert et al., 2017). A widely accepted framework, "Canadian Medical Education Directives for Specialists" (CanMEDS) defines this role as "*the demonstration of a lifelong commitment to reflective learning, as well as the creation, dissemination, application and translation of medical knowledge*" (Frank & Danoff, 2007, p. 645).

We analyse the role of physicians as teachers from a motivational (ten Cate et al., 2011) and an attitudinal (Beck et al., 2000) perspective and investigate the interrelation between these two aspects. We thereby focus on individual psychological factors which are relevant for how clinical teachers approach and enact their teaching respon-

sibilities, which didactical approaches they favour, and which role they assign to students during their courses (Richardson et al., 2014). By focusing these constructs in the medical context, we seek to advance the thriving research on factors and contextual conditions behind physicians' engagement as clinical teachers (e.g. Lochner et al., 2012; Steinert & Macdonald, 2015; van Lankveld et al., 2017).

In the motivational context we draw upon the self-determination theory of motivation (Ryan & Deci, 2000). While most physicians have not been educated as teachers, many universities currently emphasise innovative didactics, especially regarding the use of digital tools for teaching. Moreover, it may be difficult for physicians to integrate their roles as clinicians and as teachers (Cantillon et al., 2019). We therefore examine to which degree physicians perceive different kinds of motivation as being relevant for their teaching.

Regarding attitudes towards teaching, we differentiate between transmissive and constructivist approaches, drawing upon two influential learning theories (Torre et al., 2006). *Cognitivism* represents the view that knowledge can be transferred from a teacher to a learner. *Constructivism*, in contrast, is characterised by the notion that knowledge is actively constructed by the learner. Physicians possess very detailed biomedical and clinical knowledge, but are often not educated didactically, possibly entailing a more transmissive orientation towards teaching. Medicine, however, is a didactically very diverse subject area, with practical courses in and outside the patient room, simulation-based courses and a growing degree of integration of new media and digital formats in teaching. This could influence physicians in developing more modern, constructivist attitudes towards teaching.

In the following, we will provide contextual and theoretical information in order to substantiate our empirical study. First, we will differentiate forms of motivation as described in the self-determination theory and contextualise this approach in clinical teaching.

2 Context and theory

2.1 Teacher motivation: Autonomous vs. controlled

Teachers' motivation to teach has been found to influence the quality of teaching and student performance, for example students' achievement and knowledge acquisition, teachers' working and health conditions, and teacher retention (Han & Yin, 2016). Furthermore, Roth et al. (2007) found that motivation to teach is positively related to autonomous motivation to learn and negatively related to emotional exhaustion.

Self-determination theory posits that engagement in and persistence with specific behaviours (like teaching) can be predicted by the quality of an individuals' motivation. Two basic dimensions of this quality are differentiated: an autonomous and a controlled aspect (Ryan & Deci, 2000). According to Ratelle et al. (2007), autonomous motivation means that an action derives inherently from the self, while controlled motivation is observed when the origin or the governance of an action is externally controlled.

2.1.1 Autonomous motivation

Ryan and Deci (2000) differentiate various forms of autonomous motivational regulation, i.e. intrinsic regulation and identified regulation: *Intrinsic motivation* is positioned on the high end of the motivational continuum and is, according to Hein et al. (2012, p. 125), "*the prototypical form of autonomous motivation*". The reasoning behind the execution of a task or a behaviour lies in the enjoyment and contentment that this action brings to the person, rather than in its outcomes or rewards. *Identified regulation* is characterised by a lower degree of internal regulation: individuals perform actions mainly because they are in line with their own personal preferences and goals. However, compared to intrinsic motivation, identified regulation does not directly relate to individuals' passions or feelings of enthusiasm. With regard to physicians as teachers, views associated with identified motivation to teach could be that through teaching, physicians enhance their career options, obtain relevant qualifications and fulfil a role which they regard as being a relevant aspect of their profession.

Both intrinsic and identified motivation have been shown to be relevant for clinical teachers: Chapman et al. (2016) show that junior physicians are motivated by the need to develop professionally and by the happiness that teaching activities bring back to them. A similar study on senior physicians showed that their main motivation was the wish to educate medical students in a proper way. They saw teaching itself as a demanding activity and describe enthusiasm to teach and having been inspired while being students themselves (Dahlstrom et al., 2005).

2.1.2 Controlled motivation

In controlled motivation, behaviour is driven by a specific external reinforcement, which can be the desire to gain something, e.g. material rewards or appreciation by relevant others. Also, external factors can function in inhibitory ways, e.g. through sanctions connected to not performing certain actions (Kong, 2009). Ryan and Deci (2000) distinguish between two forms of controlled motivation: external and introjected regulation.

Introjected regulation is characterised by some degree of alignment between external demands and a person's individual goals and motives, because individuals internalise external motives and assign personal relevance to actions or goals which are imposed upon them. This leads to feelings of pressure, anxiety or guilt and the need to achieve approval from oneself and from other individuals.

The type of controlled motivation located at the low end of the continuum is *external regulation*, in which the underlying behaviours are reinforced by the wish to comply with orders, to acquire certain benefits, or even by the desire to avoid sanctions due to not performing certain actions (Han & Yin, 2016).

2.1.3 Situation in the current sample

The physicians in our sample (as is common in the German system) have a contractual and legal requirement to teach, but do not receive any additional payment when doing so. However, teaching may be connected to the ambition of physicians to pursue an academic career since teaching experience is a requirement for completing a *habilitation* (i.e. a further academic degree after a doctorate, which is a key step in an academic career). We hypothesise that both autonomous and controlled forms of motivation will be relevant for our respondents: For many physicians, the opportunity to share and discuss their knowledge with young colleagues in medical education is a key aspect of their academic career (Dahlstrom et al., 2005). Some previous research suggests that many teachers have higher intrinsic rather than extrinsic motivation (Ellis, 1984). However, according to Pelletier et al. (2002), teachers are less self-determined towards teaching when they perceive pressure from above (e.g. they must comply with performance standards) or from below (e.g. they realise that their students do not have a self-determined position towards the class).

Our study was conducted in the context of two professional development courses dedicated to improve clinical teachers' didactic knowledge and skills: Course one – *the lecturer workshop* – is a one-day workshop compulsory for physicians newly employed at the Klinikum rechts der Isar (the university hospital associated with the TU München where the present study was conducted, henceforth labelled as TUM MRI); course two – *the lecturer training* – is a more intensive voluntary five-day clinical teacher-training programme. We investigate whether participants in the two workshop formats perceive different types of motivational regulation as relevant for their clinical teaching: Participants in the lecturer-workshop are newly employed at the TUM MRI, the workshop is mandatory for them. Many, but not all of them, have some teaching duties. In contrast, most physicians in the lecturer training are at a more advanced stage of their career and most of them are pursuing a habilitation and require the certificate of attendance. We also take into account whether the variables gender, age and career stage are related to different types of motivation towards teaching.

Through our study, we seek to extend the literature in three ways: First, we investigate the relevance of a broad spectrum of motivational factors for clinical teachers, from intrinsic to extrinsic; second, in drawing upon quantitative methodology, we provide a different methodological perspective than most existing studies, which use qualitative approaches; third, our sample comprises physicians in different career stages, which allows us to take career-related aspects into account in our analyses. We address the following research questions regarding motivation:

RQ1: To which degree do physicians perceive different types of motivational regulation (intrinsic, identified, introjected and external) as relevant for their clinical teaching?

RQ2: How do physicians taking part in the lecturer workshop vs. the lecturer training perceive the different types of motivational regulation as relevant for their clinical teaching?

RQ3: To what extent does the perception of different types of motivational regulation as being relevant for physicians' teaching depend upon gender, age and career stage?

2.2 Teacher didactic paradigm – transmissive vs. constructivist

The second focus of our study is the didactic paradigm clinical teachers draw upon in their teaching. We focus on two guiding viewpoints, the *transmissive* vs. the *constructivist* concept (Leutner & Klauer, 2007).

2.2.1 Transmissive concept of teaching

The transmissive concept focuses the role of the teacher as an expert in a specific field who structures, didactically edits and presents subject matter so that students can understand it. Thereby, learners are guided by the teacher in their learning; however, the teacher may also purposefully orchestrate students' activity, e.g. by posing questions and assigning work tasks (Reinmann-Rothmeier & Mandl, 1994).

The transmissive concept of teaching is critically discussed for several reasons. Especially in higher education, a passive-receptive role stands in contradiction with learners' status as intellectually mature individuals on the verge of entering professions with high societal relevance and responsibility (Hodges, 2014). Also, theorists criticise the reductionist approach underlying this paradigm. Their point is that because teachers pre-structure, partition and edit subject matter to a high degree, learners are not guided towards fully comprehending its relevance and embeddedness in overarching contexts and discourses (Reinmann-Rothmeier & Mandl, 1994).

2.2.2 Constructivist concept of teaching

An alternative, more learner-centred approach is the constructivist teaching concept. One key idea of constructivism is that in essence, learning is an active and social process. It is characterised by individuals' processing and sense-making of information, whereby they actively construct new knowledge by connecting it to existing knowledge and experiences (Dennick, 2016). A key goal of constructivist didactics is to motivate learners and to wake their interest and curiosity for a specific context. This mainly occurs by confronting them with relevant and challenging problems which are then solved by the students, individually or in cooperation.

However, implementing learning environments which follow constructivist principles is challenging. On the one hand, it requires much time and effort in preparation. On the other hand, the teachers' role is not primarily an instructional one, but is better described as facilitating learning through motivation and as coaching of learners and interacting with them in critical discussion (Dennick, 2016; Duffy, Lowyk, & Jonassen, 1991; Lueddeke, 1999).

In our empirical study, we investigate to which degree respondents agree to the relevance of these concepts for their clinical teaching. Thereby, an open question is to which extent these instructional paradigms are perceived as being mutually exclusive. In this respect, we do not see these concepts as contradictory, but hypothesise that clinical teachers pragmatically integrate aspects of both conceptions. Our research questions are as follows:

RQ 4: Which groups of clinical teachers can be differentiated regarding their attitudes towards teaching?

RQ 5: Do the members of these groups differ systematically regarding their gender, age and academic title?

2.3 Relationship between physicians' motivation and attitudes towards teaching

Besides examining motivations to teach and attitudes towards teaching separately, we also investigate how these concepts are related. Studies from medical education suggest that focusing on relationships between attitudes and motivation is worthwhile, (e.g. Escher et al., 2017) but this relationship has not yet been investigated among physicians and with focus upon their teaching role. Our respective research question is:

RQ 6: Do the groups of teachers sharing specific attitude profiles towards teaching differ systematically regarding their motivation towards teaching?

3 Method

3.1 Study context and ethics

The study was conducted in context of two professional development courses dedicated to improve clinical teachers' didactic knowledge and skills: Course one – *the lecturer workshop* – is a half-day workshop every physician newly employed at the TUM MRI is required to attend. Its purpose is to inform participants about the curriculum of the medical school and give them a rough introduction to the field of didactics in medical education. Course two – *the lecturer training* – is a much more intensive clinical teacher training programme, which lasts five days. It is typically attended by more experienced physicians and addresses a variety of topics and skills relevant for medical educators, e.g. theoretical assumptions relevant for teaching in higher education, practical skills relevant for bedside teaching, simulation-based teaching and various forms of examination.

Between autumn 2017 and summer 2019, the participants in both workshops were invited to complete a questionnaire which was the basis for the present study. The questionnaire was distributed by members of the TUM Medical Education Center and collected directly after respondents had completed it so that the anonymity of respondents was maintained. The lecturer workshop is organised four times and the lecturer training two times per year by the TUM Medical Education Center. The administration staff responsible for the distribution of the questionnaire, the supervision and the data collection informed the participants about the aims of the study and the use of the data. Participation was voluntary.

Ethical approval for the study was obtained from the Klinikum rechts der Isar ethics committee (approval code 487/19 S-KK).

3.2 Participants

Our study participants (N = 314) form two groups according to the two training programmes in which they participated (see Table 1 for the age distribution in both groups). The *workshop group* included 212 participants (41.0% male, 50.5% female, 8.5% missing response). Among these, 54% had not yet acquired any academic title, while 38.7% of them were physicians (Dr. med.). The *training group* included 103 participants (68% male, 16.5% female, 15.5% no answer). In this group, no participants were under 25 or over 60 years old. In terms of their academic degrees, 93.2% had a medical doctor's-degree (Dr. med./MD) while 2.9% had obtained a PhD degree. In this group, only 1% carried no academic qualification. The training group members were more advanced in their career and most of them were pursuing a habilitation.

Table 1: Participants' age distribution

	< 25	25–29	30–39	40–49	50–59	60 +
Lecturer workshop	1%	54.7%	33.5%	7.2%	1%	1%
Lecturer training		4.9%	77.7%	12.6%,	1.9%	

3.3 Measures

Motivation to teach was assessed by a questionnaire scale adapted from Ryan and Connell (1989), which had been used in various studies since (e.g. Johannes, Fendler, Hoppert, & Seidel, 2011). It consisted of 13 items and a four-point Likert scale ranging from 1 (does not apply) to 4 (totally applies, see Table 3 for means and standard deviation values of questionnaire scales). The items were organised in four subscales according to the spectrum of motivation: The intrinsic motivation-subscale consisted of 4 items (α = .76, sample item "I teach because teaching gives me pleasure"). Identified motivation was measured with a 3-item subscale (α = .57, sample item "I teach in order to obtain further qualifications, e.g. a habilitation"). Due to the alpha-value being at the threshold of acceptability (Gliem & Gliem, 2003), we decided to include it in our further analyses, but consider respective outcomes as explorative. The facet of introjected motivation was measured by means of a 3-item scale (α = .70, sample item "I teach because I would feel guilty if I wouldn't"). Extrinsic motivation was measured using 3 items (α = .80, item example "I teach because otherwise, I get pressure from my supervisors").

The questionnaire used to measure subjective teaching concepts consisted of 14 items and was adapted from Kauper et al. (2012). Seven of these items were related to the transmissive, the other seven items to the constructivist teaching concept. The items are displayed in Table 1, along with mean values and standard deviations (items are sorted in descending order of mean values).

Table 2: Items relating to the transmissive and constructivist teaching concept

Teaching concept	Item	*M*	*SD*
Transmissive	demonstrating	3.31	.70
	lecturing	2.82	.71
	distributing work assignments	2.54	.84
	repeating key phrases	2.52	.90
	inculcating	2.43	.87
	writing on the blackboard	2.16	.85
	controlling	1.94	.81
Constructivist	arousing interest	3.88	.38
	encouraging	3.63	.57
	asking questions	3.56	.60
	scrutinising	3.49	.69
	accompanying	3.32	.66
	allowing	3.04	.72
	researching	3.03	.83

3.4 Statistical analyses

We used MANOVAs to test differences in types of motivation to teach between the workshop and the training group and between groups based on gender, age and academic title. To investigate participants' agreement to the transmissive vs. the constructivist teaching concepts, we conducted a latent class analysis (LCA). To determine the optimal number of latent classes, we relied on the Bootstrap Likelihood Ratio Test (BLRT; McLachlan & Peel, 2000; Nylund et al., 2007) and several further information criteria (Consistent Akaike Information Criterion (CAIC), Bayesian Information Criterion (BIC) and the Approximate Weight of Evidence Criterion (AWE; Masyn, 2013)). For interpreting the LCA, we report expectation values for all items on the four-type Likert scale for each latent class. These values are calculated based only upon the values of participants who responded to the specific item. Non-responders are excluded and the probability of non-response is taken into account (if this probability is >0% in the model). All analyses were done with R 4.0.0 (R Core Team, 2020) using the poLCA-package (Linzer & Lewis, 2011). The BLRT was adapted using functions from the e1071 (Meyer et al., 2019) and the doSNOW-packages (Microsoft Corporation & Weston, 2019).

4 Results

4.1 Motivation to teach

(RQ1) Overall, clinical teachers in our sample reported higher agreement regarding the aspects of autonomous as compared to the controlled motivation (cf. Table 3). A direct comparison of both overarching concepts (autonomous: $M = 2.98$, $SD = .53$; controlled: $M = 1.61$, $SD = .51$) revealed a statistically significant effect with large effect size, $t(308) = 99.6$, $p < .01$, $d = -2.64$.

(RQ2) Accordingly, we found higher mean values regarding autonomous (intrinsic and identified) as compared to controlled types of motivation (introjection and external regulation) in both groups (workshop and training, cf. Table 3). The correlations between the different aspects of motivational regulation had a plausible pattern, with positive associations between the autonomous and controlled types of regulation and no or negative cross-correlations. Also, this meets the MANOVA assumption of moderate correlation between the dependent variables (Gamst et al., 2008).

Table 3: Motivation to teach – mean values and standard deviations in different levels of motivation, in different training groups and correlation values in the full sample

	Autonomous motivation		Controlled motivation	
	1. Intrinsic *M (SD)*	2. Identified *M (SD)*	3. Introjected *M (SD)*	4. External *M (SD)*
Overall ($n = 314$)	3.07 (.61)	2.89 (.67)	1.64 (.63)	1.57 (.69)
Workshop ($n = 211$)	3.12 (.59)	2.82 (1.09)	1.69 (.63)	1.63 (.68)
Training ($n = 103$)	3.02 (.61)	3.18 (.50)	1.55 (.62)	1.43 (.65)
1.	1	.33**	–.01	–.37**
2.		1	.13*	-.14*
3.			1	.27**
4.				1

Note. * p<.05, ** p<.01

On this basis, mean values of different types of motivation between the workshop and training groups were compared using MANOVA. We found a statistically significant overall effect, Pillais' Trace = .101, $F(4, 239) = 6{,}692$, $p < .001$, and the estimate of the multivariate effect size value was $\eta^2 = .10$. This indicates that an amount of 10% of the variance of the dependent variables could be accounted for by membership in the workshop vs. training group.

Regarding motivation, two significant differences were found: First, participants in the lecturer training reported significantly higher values for identified motivation ($p < .01$, $\eta^2 = .03$); second, participants in two groups differed significantly regarding external motivation ($p < .05$, $\eta^2 = .02$), with the workshop group showing higher values (cf. Table 3).

(RQ3) Further, we also sought to determine the influence of gender, age and career stage on different types of motivational regulation for teaching. For this purpose, we also calculated a MANOVA, whereby our overall model was not statistically significant, Pillais' Trace = .99, $F(20, 988) = 1{,}255$, $p = .20$.

However, regarding the different variables, we found a significant effect of age regarding extrinsic motivation ($p < .05$, $\eta^2 = .04$). Also, we found a significant interaction effect between age and gender regarding extrinsic motivation ($p < .05$, $\eta^2 = .04$). This means that older, male respondents in our sample reported higher degrees of extrinsic motivation.

4.2 Attitudes towards teaching

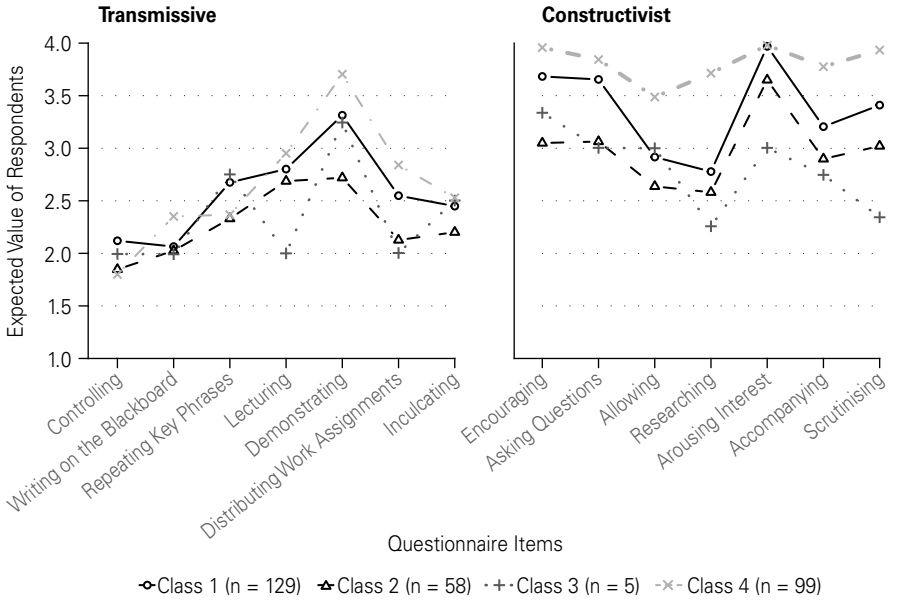
RQ4 concerns the differentiation of clinical teachers regarding their attitudes towards teaching. We conducted LCAs to answer this question. As Table 4 shows, while the further information criteria pointed towards two or even one class, we favoured a solution in which four latent classes were differentiated. This decision was made based upon the BLRT value and the fact that differences between the four latent classes seemed practically relevant and easy to interpret.

Figure 1 shows the results which best represented our data. This solution differentiates four latent classes characterised by their agreement to the relevance of the different teaching activities and to specific non-response patterns. The left half of Figure 1 shows the items related to the transmissive, the right half shows the items related to the constructivist teaching concept.

Table 4: Information criteria for models with different latent classes

Latent classes in model	df	–2*log-likelihood	BIC	CAIC	AWE	BLRT	
						$\Delta_{-2loglik}$	*p*
One	237	8,580.1	8,887	8,941	*9,193*		
Two	182	8,180.2	*8,799*	*8,908*	9,418	399.9	.000
Three	127	8,011.0	8,941	9,105	9,874	169.2	.001
Four	**72**	**7,885.7**	**9,128**	**9,347**	**10,373**	**125.3**	**.002**
Five	17	7,810.8	9,365	9,639	10,923	74.9	.239

Figure 1: Latent profiles of agreement to teaching activities related to the transmissive and the constructivist teaching concept



Overall, the items relating to the constructivist teaching concept (right half of Figure 1) receive higher agreement than the items that relate to the transmissive concept. Beyond this, several latent classes were differentiated: The largest *class one* comprises 129 individuals and is characterised by high agreement (>3.0) to one transmissive item ("demonstrating") and to five out of seven of the constructivist items. The individuals in class one see "arousing interest" as essential in their teaching. Also, they judge "encouraging" and "asking questions", "demonstrating" and "scrutinising" as very important teaching activities. For them, the least important aspects of teaching are "controlling" and "writing on the blackboard". Further, respondents in class one show the lowest overall non-response.

The *class two* profile consisted of 58 respondents and mirrors the overall response pattern of profile one – yet on a lower level of agreement to almost all items, and is also characterised by very low non-response. The only apparent difference appeared in the transmissive item "demonstrating", which the class two respondents did not see as particularly relevant.

Class three only consisted of five individuals, who showed high non-response of up to 60%. For these reasons, it is difficult to reliably interpret our findings here. The class three individuals do not seem to generally favour either of the two teaching concepts.

Instead, they regard some few instructional elements as very relevant ("demonstrating", "encouraging") for their teaching, but clearly reject other aspects ("controlling", "writing on the blackboard", "lecturing", "distributing work assignments", "researching" or "scrutinising").

The *class four* profile comprised 99 clinical teachers, who clearly favour the constructivist teaching concept and showed a low degree of non-response. In particular, they exhibit almost perfect agreement (3.5–4.0) to all constructivist items and to the transmissive item "demonstrating". In contrast, they showed substantially lower agreement to all other items from the transmissive concept. Regarding the item "controlling", class four shows the lowest agreement value in the entire study (but with only a small difference to the class 2 value).

Regarding *RQ5*, we focus the question whether the members of the latent profiles differ systematically regarding their gender, age and academic title. Table 5 shows the respective distributions.

Despite none of the four profiles seems dominated by males or females, profile two shows a slight overrepresentation of male physicians. Regarding age, the median age group of all latent classes is 30–39 and the differences between percentages of age group members between the various classes are small. Hence, no substantial differences could be identified here.

With respect to academic title, the categories were "study" (the final degree of a specific programme, mostly medicine in our case), "doctorate" (PhD or MD), "assistant professor" (Privatdozent or PD in German) and "associate professor" (Apl. Prof. in German). The median value of 2, doctorate, was equal in all classes, and no significant differences emerged between the individuals in the various latent profiles.

Table 5: Distribution of sex, age and tenure in the latent profiles in absolute numbers (in italics) and percentages

	Sex		Age						Academic title			
#	m	f	<25	25–29	30–39	40–49	50–59	60+	Study	Doctorate	Asst. Prof.	Assoc. Prof.
n	*56*	*44*	*0*	*38*	*50*	*9*	*2*	*0*	*37*	*58*	*0.6*	*0.6*
1	55	44	0	50	40	57	40	100	45	45	50	100
2	63	37	0	14	23	18	20	0	15	22	50	0
3	0	100	0	1	1	4	0	0	2	1	0	0
4	53	47	100	36	35	21	40	0	38	32	0	0

Note. # = number of latent profile; m = male; f = female; in each box of solid lines, numbers add up to 100% (exceptions are due to rounding errors).

Finally, regarding *RQ6,* we investigated whether the members in the latent profiles differ regarding their agreement to the different motivation scales. We could not find any statistically significant differences in this respect.

5 Discussion

In the present study, we investigated the role of physicians as clinical teachers drawing upon motivational and attitudinal variables. The following discussion is structured along the research questions addressed in our study. Then, we address study limitations and draw further, more general conclusions.

The first research question targeted the degree to which physicians report different types of motivational regulation as being relevant for their clinical teaching. In line with previous research, results showed, with large effect size, that physicians reported higher scores for autonomous (intrinsic and identified) motivation when compared to controlled types of motivation.

However, our model only explained 10% of variance in the dependent variables. This shows that beyond the variables in focus of our study, other important predictors of motivation to teach exist (cf. Kusurkar et al., 2011). Furthermore, two differences regarding motivation to teach were found:

First, clinical teachers who were more advanced in their career, were teaching regularly and were in process of their habilitation reported higher values for identified motivation. This aspect is associated with the notion that teaching is a key aspect of the medical profession and that respective experiences are important for advancing one's career. The finding supports the description by Steinert et al. (2015) that teaching in medical higher education is associated with positive emotions, but also with strategic advantages, e.g. with regard to the chance to identify promising students and recruit them or – as is more relevant in the present study – regarding the fulfilment of the formal requirements for a habilitation. This dual character comprising internal and external aspects clearly relates to the idea of identified regulation. However, due to the low reliability of the respective questionnaire scale, we consider this outcome explorative and argue that it should be further verified in future research.

Second, we found that physicians in the lecturer workshop reported higher external motivation, but with small effect size. This outcome might simply reflect the fact that these physicians had to attend the workshop. In principle, extrinsic motivation is unproblematic, as long as it does not induce detrimental effects, like e.g. overjustification (Akin-Little & Little, 2019). From the perspective of curriculum design, we argue

that a concise didactic course can contribute to nudge (Hargreaves, 2013) physicians towards seeing teaching and didactics as a relevant topic at a university hospital.

Further, we investigated differences in types of physicians' motivation to teach depending upon gender, age and career stage. Here, we found that elder, male respondents reported higher degrees of extrinsic motivation. In the sample investigated here, attendance in the lecturer training was related to completing habilitation as a further academic degree (which is a non-altruistic motive). It seems that male respondents who were more advanced in their career perceived a certain degree of dissatisfaction with being urged to attend a didactic seminar as a prerequisite for completing their habilitation. However, as the respective effects showed very small effect sizes, generalisation of these outcomes does not seem warranted.

The second focus of our study are physicians' attitudes towards teaching. Our results show that overall, physicians regarded both the transmissive and the constructivist teaching concept as being relevant for their teaching. However, agreement to constructivist teaching activities was even higher. This relates to key elements of reforms that affected medical education over the last decade, like the growing importance of simulation-based learning (Griswold-Theodorson et al., 2015) or the focus upon competencies like communication and interprofessional cooperation (Baartman & de Bruijn, 2011). Clinical teachers' agreement-patterns that emerged in our study reflect this trend towards more learner-centred instructional formats, especially given the high agreement values to behaviours like "encouraging", "arousing interest" or "accompanying". However, a critical question which cannot be answered based on the present results is to which degree this favour towards constructivist instructional orientations actually translates into teaching practice. Observational studies could help clarifying this point in the future.

When relating teaching concepts to teaching motivation, we found no specific differences regarding teaching motivation between the respondents in the different attitude profiles in our study. Preferred concepts of teaching, therefore, seem to be developed independently of the reasons behind physicians' teaching activities. Finally, we found no statistically significant differences in the latent profiles regarding respondents' gender, age and academic title.

Regarding limitations, our study relied entirely on questionnaire data. Known biases, like social desirability (Bortz & Döring, 2009), might have affected its outcomes. In particular, latent class #4 responded like model lecturers highly engaged with innovative, constructivist viewpoints. In part, these individuals could be biased by assumptions that responding in this fashion would cast a positive light on them and their colleagues. Also, the study was embedded in two didactic course formats, the lecturer

workshop and the lecturer training –, which both are dedicated to foster competence and motivation in medical education. Being immersed in discussions around what is good and innovative medical education might have led them to rate their motivation as being higher and their attitudes as being more positive as they would have done during their usual daily work routine.

In sum, the results of our study show that clinical teachers' motivation to teach is dominantly regulated autonomously – but with controlled motives also playing a role. Also, clinical teachers' attitudes towards teaching are dominated by the constructivist approach. However, none of the two approaches is fundamentally rejected, respondents' agreement/disagreement seemed pragmatically motivated. Overall, one could conclude that the clinical teachers' motivation and attitude patterns we found are a fruitful basis for implementing innovative didactics and educational methods in higher education in the medical context. Various studies highlight that staff development courses for medical teachers have substantial potential to spark transformations in attitudes towards teaching and teaching practices (Steinert et al., 2006; Weurlander & Stenfors-Hayes, 2008). Focusing upon motivational aspects is crucial in this context because, on the one hand, physicians seem very reluctant to engage in such programmes if they do not see any concrete benefits for themselves (van Bruggen et al., 2020). On the other hand, very personal and altruistic motives, like personal growth and giving things back to a relevant professional community, are also described in the literature (Steinert & Macdonald, 2015). In this respect, the quasi-longitudinal approach adopted in the present study is limited. So, future studies should adopt a longitudinal perspective on the question of how teaching-related motivation and attitudes of clinical teachers develop across their (academic) career. Clarke and Hollingsworth (2002) differentiate various dimensions of teacher change, e.g. change as training (i.e., as an external influence instigating potentially transformative processes in teachers), change as personal development (understood as an internal process of transformation of skills or routines) or change as systemic restructuring – meaning that teachers enact change agendas which are decided by their superiors. Future research on clinical teachers' attitudes towards teaching and their motivation to teach should adopt more diverse perspectives and strive to simultaneously focus the spectrum of external and internal forces which drive clinicians to teach medical students.

References

Akin-Little, A., & Little, S.G. (2019). Effect of extrinsic reinforcement on "intrinsic" motivation: Separating fact from fiction. In S.G. Little, & A. Akin-Little (Eds.), *Behavioral interventions in schools: Evidence-based positive strategies* (pp. 113–132). American Psychological Association.

Baartman, L.K., & de Bruijn, E. (2011). Integrating knowledge, skills and attitudes: Conceptualising learning processes towards vocational competence. *Educational Research Review, 6*(2), 125–134.

Beck, J., Czerniak, C.M., & Lumpe, A.T. (2000). An exploratory study of teachers' beliefs regarding the implementation of constructivism in their classrooms. *Journal of Science Teacher Education, 11*(4), 323–343.

Bortz, J., & Döring, N. (2009). *Forschungsmethoden und Evaluation*. Heidelberg: Springer.

van Bruggen, L., ten Cate, O., & Chen, H.C. (2020). Developing a Novel 4-C Framework to Enhance Participation in Faculty Development. *Teaching and Learning in Medicine*, *32*(4), 1–9.

Busari, J.O., Scherpbier, A.J., van der Vleuten, C.P., & Essed, G.G. (2003). The perceptions of attending doctors of the role of residents as teachers of undergraduate clinical students. *Medical Education, 37*(3), 241–247.

Cantillon, P., Dornan, T., & de Grave, W. (2019). Becoming a clinical teacher: identity formation in context. *Academic Medicine, 94*(10), 1610–1618.

ten Cate, O., Kusurkar, R.A., & Williams, G.C. (2011). How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE guide No. 59. *Medical Teacher, 33*(12), 961–973.

Chapman, R., Burgess, A., McKenzie, S., & Mellis, C. (2016). What motivates junior doctors to teach medical students? *MedEdPublish*, *5*(2).

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education, 18*(8), 947–967.

Dahlstrom, J., Dorai-Raj, A., McGill, D., Owen, C., Tymms, K., & Watson, D.A.R. (2005). What motivates senior clinicians to teach medical students? *BMC Medical Education, 5*(1), 1–10.

Dennick, R. (2016). Constructivism: reflections on twenty five years teaching the constructivist approach in medical education. *International Journal of Medical Education, 7,* 200–205.

Duffy, T.M., Lowyk, J., & Jonassen, D.H. (1991). *Designing Environments for Constructive Learning*. Berlin: Springer.

Ellis, T.I. (1984). *Motivating Teachers for Excellence*. ERIC Clearinghouse on Educational Management: ERIC Digest.

Escher, C., Creutzfeldt, J., Meurling, L., Hedman, L., Kjellin, A., & Felländer-Tsai, L. (2017). Medical students' situational motivation to participate in simulation based team training is predicted by attitudes to patient safety. *BMC Medical Education, 17*(1), 1–7.

Frank, J.R., & Danoff, D. (2007). The CanMEDS initiative: implementing an outcomes-based framework of physician competencies. *Medical Teacher, 29*(7), 642–647.

Gamst, G., Meyers, L.S., & Guarino, A.J. (2008). *Analysis of variance designs: A conceptual and computational approach with SPSS and SAS*. Cambridge: University Press.

Gliem, J.A., & Gliem, R.R. (2003, October). Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales [Paper presentation]. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education, The Ohio State University, Columbus, OH.

Griswold-Theodorson, S., Ponnuru, S., Dong, C., Szyld, D., Reed, T., & McGaghie, W.C. (2015). Beyond the simulation laboratory: a realist synthesis review of clinical outcomes of simulation-based mastery learning. *Academic Medicine, 90*(11), 1553–1560.

Han, J., & Yin, H. (2016). Teacher motivation: Definition, research development and implications for teachers. *Cogent Education, 3*(1), 1–18.

Hargreaves, A. (2013). *Push, pull and nudge: The future of teaching and educational change.* In X. Zhu, & K. Zeichner (Eds.), *Preparing teachers for the 21st century* (pp. 217–236). Berlin, Heidelberg: Springer.

Hein, V., Ries, F., Pires, F., Caune, A., Ekler, J.H., Emeljanovas, A., & Valantiniene, I. (2012). The relationship between teaching styles and motivation to teach among physical education teachers. *Journal of Sports Science & Medicine, 11*(1), 123.

Hodges, B.D. (2014). *The question of competence: Reconsidering medical education in the twenty-first century*. Ithaca: Cornell University Press.

Johannes, C., Fendler, J., Hoppert, A., & Seidel, T. (2011). *Projekt LehreLernen (2008-2010): Dokumentation der Erhebungsinstrumente*. Münster: Monsenstein und Vannerdat.

Kauper, T., Retelsdorf, J., Bauer, J., Rösler, L., Möller, J., Prenzel, M., & Drechsel, B. (2012). *PaLea – Panel zum Lehramtsstudium.* Kiel: IPN. Retrieved 07.07.2021 from https://www.palea.uni-kiel.de/wp-content/uploads/2012/04/PaLea%20Skalendokumentation%201_%20Welle.pdf.

Kong, Y. (2009). A brief discussion on motivation and ways to motivate students in English language learning. *International Education Studies, 2*(2), 145–149.

Kusurkar, R., ten Cate, T.J., van Asperen, M., & Croiset, G. (2011). Motivation as an independent and a dependent variable in medical education: a review of the literature. *Medical Teacher, 33*(5), e242–e262.

van Lankveld, T., Schoonenboom, J., Croiset, G., Volman, M., & Beishuizen, J. (2017). The role of teaching courses and teacher communities in strengthening the identity and agency of teachers at university medical centres. *Teaching and Teacher Education, 67*, 399–409.

Leutner, D., & Klauer, K.J. (2007). *Lehren und Lernen: Einführung in die Instruktionspsychologie*: Weinheim: Beltz.

Linzer, D.A., & Lewis, J.B. (2011). poLCA: An R Package for Polytomous Variable Latent Class Analysis. *Journal of Statistical Software, 42*(10), 1–29.

Lochner, L., Wieser, H., & Mischo-Kelling, M. (2012). A qualitative study of the intrinsic motivation of physicians and other health professionals to teach. *International Journal of Medical Education, 3*, 209–215.

Lueddeke, G.R. (1999). Toward a constructivist framework for guiding change and innovation in higher education. *The Journal of Higher Education, 70*(3), 235–260.

Masyn, K.E. (2013). 25 Latent Class Analysis and Finite Mixture Modeling. In T. Little (Ed.), *The Oxford Handbook of Quantitative Methods* (pp. 551–611). Oxford: University Press.

McLachlan, G., & Peel, D. (2000). *Finite mixture models*. New York: Wiley.

Meyer, D., Dimitriadou, E., Hornik, K., Weingessel, A., & Leisch, F. (2019). *e1071: Misc Functions of the Department of Statistics, Probability Theory Group (Formerly: E1071).* TU Wien. R package version 1.

Microsoft Corporation, & Weston, S. (2019). *doSNOW: Foreach Parallel Adaptor for the 'snow' Package*. R package version 1.0.18.

Nylund, K.L., Asparouhov, T., & Muthén, B.O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling: A Multidisciplinary Journal, 14*(4), 535–569.

Pelletier, L.G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology, 94*(1), 186.

R Core Team. (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from https://www.R-project.org/

Ratelle, C.F., Guay, F., Vallerand, R.J., Larose, S., & Senécal, C. (2007). Autonomous, controlled, and amotivated types of academic motivation: A person-oriented analysis. *Journal of Educational Psychology, 99*(4), 734.

Reinmann-Rothmeier, G., & Mandl, H. (1994). *Wissensvermittlung: Ansätze zur Förderung des Wissenserwerbs* (Forschungsbericht Nr. 34). LMU München: Lehrstuhl für Empirische Pädagogik und Pädagogische Psychologie.

Richardson, P.W., Karabenick, S.A., & Watt, H.M. (2014). *Teacher motivation: Theory and practice*. London: Routledge.

Roth, G., Assor, A., Kanat-Maymon, Y., & Kaplan, H. (2007). Autonomous motivation for teaching: How self-determined teaching may lead to self-determined learning. *Journal of Educational Psychology, 99*(4), 761–774.

Ryan, R.M., & Connell, J.P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology, 57*(5), 749–761.

Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78.

Steinert, Y., Basi, M., & Nugus, P. (2017). How physicians teach in the clinical setting: the embedded roles of teaching and clinical care. *Medical Teacher, 39*(12), 1238–1244.

Steinert, Y., & Macdonald, M.E. (2015). Why physicians teach: giving back by paying it forward. *Medical Education, 49*(8), 773–782.

Steinert, Y., Mann, K., Centeno, A., Dolmans, D., Spencer, J., Gelula, M., & Prideaux, D. (2006). A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education. BEME Guide No. 8. *Medical Teacher, 28*(6), 497–526.

Torre, D.M., Daley, B.J., Sebastian, J.L., & Elnicki, D.M. (2006). Overview of current learning theories for medical educators. *The American Journal of Medicine, 119*(10), 903–907.

Weurlander, M., & Stenfors-Hayes, T. (2008). Developing medical teachers' thinking and practice: Impact of a staff development course. *Higher Education Research & Development, 27*(2), 143–153.

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What qualities in teachers are valued by medical students?

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In order to develop their didactic expertise, teachers need to know which aspects of their teaching are positively evaluated by the students. This is especially important for teachers in medical education because education is not their main task. This means that there are often limited opportunities for developing their teaching skills. The aim of this study is therefore to discover which qualities in teachers are most valued by medical students. Based on the comments of students on 30 courses in the first, second and third year of the medical school in Utrecht, we identified the following top 10 qualities: good explanation; clarity; good pace; good preparation; enthusiasm; good structure; enjoyable (including humour); stimulating/motivating; knowledgeable; instructive/informative. In this article, the results are supported by comments from students and a comparison is made with existing research from other domains. Recommendations for further research and (medical) educational practice are given.

1 Introduction

A prerequisite for good medical education is good teachers. Previous research shows that teaching skills correlate with academic achievement and the acquisition of medical expertise by students (Hwang et al., 2017). In medicine, most teachers are also physicians, for whom teaching is a minor part of their responsibilities (van den Berg et al, 2013; van Bruggen et al., 2020). Since they are primarily occupied with patient care and in many cases research as well, there is often little time for teaching. That means that there are limited opportunities for developing didactic expertise. Several authors have written about the development of teaching skills in general and for medical education in particular. In his "model of teacher change", Guskey (2002) describes the process that teachers go through in their development from inexperienced to experienced teachers. As with all new skills, both time and effort are needed to refine and optimise the role of teachers. In addition, teachers require regular feedback on their teaching. Clarke and Hollingsworth (2002) indicate that it is important that teachers receive information about their performance and that they are able to reflect on it. Many formal faculty development programmes tie in with this. Through learning by doing, in which teachers apply the theory they have learned in practice, they improve their performance through feedback and reflection (Steinert et al., 2016). In addition to faculty development and feedback, it is important for teachers to work

in an environment that stimulates development and gives them the opportunity to do so (Clarke & Hollingsworth, 2002). Van Bruggen et al. (2020) emphasise that this context is especially relevant in medical education – physicians must be given time and support by their organisation in their role as teachers.

Besides the importance of professional development, it is important that teachers are motivated for and feel committed to this role, especially if this is a task that is additional to other essential duties. Van den Berg et al. (2013) have examined the factors that contribute to work engagement and motivation for teaching at medical schools. Their study showed that the most important factor in underpinning teachers' engagement is feedback on their teaching performance, which is also crucial in motivating their teaching.

As described above, it is essential that medical teachers receive feedback on their teaching. That is why most medical schools and other institutions of higher education have a system allowing students to evaluate their various courses (Benton & Cashin, 2011; Knol et al., 2016; Marsh, 2007). In practice, this means that at the end of a course, students assess the course on a range of aspects, such as organisation, content, teacher interaction and exams. The most common method used involves students awarding a quantitative score for different components, and often also for the course as a whole, along with opportunity to explain their scores in a short written text (Benton & Cashin, 2011; Knol et al., 2016). Although this information provides relevant feedback in the context of the university's quality assurance, it is often of limited benefit as feedback in helping individual teachers to advance their pedagogical expertise (Beran & Rokosh, 2009). Teachers feel that these evaluations do not reveal the complexity of the profession, or the underlying choices and attendant constraints (Burden, 2008). This also fits in with the finding that courses which students find difficult or uninteresting are rated less positively, independent of the teacher's expertise (Benton & Cashin, 2011).

Another problem, particularly prevalent in medicine, is that multiple teachers are often involved in the delivery of a single course. Research conducted by Uijtdehaage and O'Neal (2015) shows that it makes little sense to have students evaluate all individual teachers at the end of a course. Many students cannot remember whether they have seen a certain teacher, let alone give them specific feedback. A study by Hoban and Hastings (2006) shows that teachers benefit most from student feedback if it is given during personal interviews. The disadvantage of this method is that it is very time-consuming, both for teachers and students. In addition, students may find it difficult to give feedback to teachers in a direct dialogue.

To address the problems described above, at the medical school in Utrecht (The Netherlands), a question is added to the regular questionnaires, allowing students to indicate which teachers they particularly value and to substantiate their choices. In addition to the fact that these results are important and motivating for the teachers concerned, it also provides general information about which teaching qualities medical students value and find useful for the learning process. This information can be used in faculty development programmes and to give useful input to (other) medical teachers. Overviews of the qualities of good teachers have been drawn up previously (Kreber, 2002; Marsh, 2007). Two commonly used research-based overviews are "Feldman's Categories of Effective Teaching" and the factors of the "Students' Evaluations of Educational Quality (SEEQ)" (Marsh & Hocevar, 1991). Feldman's categories, the first version of which was developed in 1976, are based on research into the opinions of teachers and students. The SEEQ factors were developed on the basis of a literature review, after which teachers and students were asked to rate the various items to determine the aspects they consider important for effective teaching (Marsh & Hocevar, 1991; Marsh, 2007). However, neither of these overviews is tailored to medical education and medical students.

There are several reasons to assume that medical students are divergent in the expectations they have of their teachers in comparison with students from other university programmes.

Medical students often know at an early age that they want to become physicians. Gaining admission to medical school is difficult everywhere in the world (Patterson et al., 2019). Students often have to obtain high grades in secondary education in order to be admitted at all, and often have to support their studies with part-time jobs in health care to finance them. This means, on the one hand, that medical students are used to studying hard and are very motivated to do so, but also that they may be critical and possibly expect high quality teaching. Previous research has shown that there is a relationship between motivation and evaluation scores. This may also apply to judgements about individual teachers (Benton & Cashin, 2011). Medical school programmes also differ from other university programmes in certain respects. Students have to acquire a great deal of knowledge in a short period of time, and this is continually tested. In many countries, in addition to their internal examinations, students also have to take state examinations or progress tests (Melnick et al, 2002; Nikendei et al., 2012; Schuwirth & van der Vleuten, 2012). In addition, the road to becoming a physician is a long one, often involving selection procedures before progressing to the next phase (Patterson et al, 2019; Wijnen-Meijer et al., 2013). It is therefore clear that medical students must be able to acquire knowledge quickly and efficiently. Teachers obviously play a major role in facilitating this.

Finally, most medical schools worldwide have become vertically integrated over the last 20 years (Brauer & Ferguson, 2015), which means that clinical practice and patient cases are a feature of their studies from the outset. This is also how the curriculum in Utrecht is designed, where the research project reported here was conducted. This means that the courses are clinically oriented from the start and that all courses are taught mainly by physicians. This in turn means that the education provided is not easily comparable to the theoretically oriented education on other university programmes.

For these reasons, the analysis of the opinions of medical students on what constitutes good teachers offers a valuable addition to the existing literature.

The study aimed to gain insight into the qualities of teachers who are valued by preclinical medical students. In addition, we compared our results with existing overviews of good teaching qualities in the literature. Our primary aim was to contribute to the literature on teachers in medical education, but there are also practical applications. The results can be used as input for the development of faculty development and evaluation systems, as well as to provide feedback to teachers based on observations.

2 Methods

2.1 Data collection

The data were collected in the period 2015–2018 on 30 courses in the first, second and third year studies at the medical school in Utrecht. All these courses relate to a particular medical topic (e.g. circulation or cancer) and include all types of education (e.g. lectures, practical trainings, seminars, anatomy education, and discussion of patient cases). For these courses, the following question was added to the standard course evaluation: *Which teachers in this course did you particularly appreciate? You can mention a maximum of 3 names. This may include any form of teaching (lecture, practical training, seminar, etc.). Please also give an explanation with each name: Why did you like this teacher?*

The results relate to course evaluations on a specific medical topic (e.g. circulation), which include all types of education, such as: lectures, practical trainings, seminars, anatomy education, and discussion of patient cases.

We chose to ask this open, qualitative question because we wanted to obtain individual, non-directive opinions formulated in the students' own words.

2.2 Data analysis

For the purpose of this research, all comments made by students, independent of the course or the teacher, have been analysed thematically, by means of open coding to identify themes (Boeije, 2005; Braun & Clarke, 2006). In order not to confine or prejudice the survey, we chose to take the students' comments as a starting point and assign codes to them, rather than coding them on the basis of themes described in the literature. A preliminary coding scheme was constructed by one of the researchers. If a comment contained multiple themes, this comment was split into two or more parts. Based on the resulting coding scheme, two of the researchers coded part of the data set and inter-rater reliability was highly reliable (Landis & Koch, 1977). The Kappa Measure of Agreement value was .80, with a significance of $p < .0005$. Subsequently, two of the researchers each coded half of the dataset independently. Themes were further refined during coding and additional codes were added. New codes and ambiguous comments were discussed by the two coders until consensus was reached. As a result, each comment was linked to one or more themes. In order to determine which teaching qualities were most valued by the students, we enumerated the frequency of occurrence of each theme.

2.3 Comparison with the literature

We compared the themes we found with existing lists of teaching qualities in the literature, specifically: "Feldman's Categories of Effective Teaching", the factors of "Students' Evaluations of Educational Quality (SEEQ)" (Marsh, 2007) and the results of a review of the qualities of good clinical teachers (Sutkin et al., 2008).

2.4 Ethical Approval

Ethical approval was obtained in 2016 from the NVMO Ethical Review Board.

3 Results

3.1 Response

On average, around a third of students on each course (n = 96) answered the question with respect to one or more teachers. While many students used a few keywords ("*well-structured and stimulating*"), others wrote down more elaborate answers ("*Mainly because his delivery is not too fast, clear, well-structured and pitched to our level, using a touch of humour now and then to keep us engaged*"). On average, students mentioned two qualities per teacher (M = 1.9; SD = 1.0). In total, 4,328 comments were labelled with a theme.

3.2 Qualities of good medical teachers

The overview of all themes and the number of times each theme occurs can be found in Table 1. In total, 40 themes were identified. Two-thirds (66%) of the comments cover one of the top 10 themes. We found the following top 10 reasons why a teacher is mentioned by students: good explanation; clarity; good pace; good preparation; enthusiasm; good structure; enjoyable (including humour); stimulating/motivating; knowledgeable; instructive/informative. In Table 2, each theme from this top 10 is further explained and illustrated with quotes.

3.3 Comparison with existing overviews

In order to determine to what extent there is similarity with the themes we found, we compared in Table 3 these themes with "Feldman's categories of effective teaching", "Students' Evaluations of Educational Quality Factors (SEEQ)" (Feldman, 1976; Marsh & Hocevar, 1991; Marsh, 2007), and the qualities of good clinical teachers as described in the literature review by Sutkin et al. (2008).

Most of the listed themes can also be found in "Feldman's categories of effective teaching" (Marsh, 2007). These include: "clarity and understandableness", "elocutionary skills", "enthusiasm", "preparation and organisation", "stimulation of interest/intellectual challenge" and "subject knowledge/intellectual expansiveness". In total, Feldman describes 20 categories. Our theme "enjoyable/humour" does not appear in Feldman's list. Categories of Feldman's top 10 that appear lower down on our list are "sensitivity to class progress", "clarity of objectives" and "value of course materials". "Clarity and understandableness", which clearly transcend all other themes on our list (themes 1 and 2), is ranked 6th in Feldman's list.

The themes in our top 10 can be matched with 5 of the 9 SEEQ Factors (Marsh, 2007). These are "instructor enthusiasm", "breadth of coverage", "organisation/clarity", "learning/value" and "workload/difficulty". The factors "group interaction" and "individual rapport" could also be matched with themes from our list, but were ranked below the top 10. The factors "examinations/grading" and "assignments/readings" do not appear among our themes.

4 of 5 categories of good clinical teachers, as described in the literature review by Sutkin et al. (2008), are also part of our top 10. These are: "medical/clinical knowledge", "clinical and technical skills/competence", "communication skills" and "enthusiasm". Their 5th category, "positive relationships with students and supportive learning environment", matches themes that are lower in our ranking, namely "engaged/interested in students" (place 23) and "pleasant atmosphere" (place 31).

4 Discussion

The aim of the study described in this article was to gain insight into the qualities of teachers who are valued by medical students. Students seem able to formulate eloquently why they value a specific teacher. What is striking is that the students in our study find "good explanation" and "clarity" especially important. This may have to do with the specific participants. In the preclinical phase of medical school, most exams are based on understanding theory. That is why it is important for students that it is explained well and clearly.

Most of the themes mentioned by the medical students can also be found in "Feldman's categories of effective teaching", "Students' Evaluations of Educational Quality Factors (SEEQ)", and the literature review into qualities of good clinical teachers (Sutkin et al., 2008). It is interesting that enjoyable/humour was high on our list, but is completely absent from Feldman's categories. As the students indicated that this helped to hold their attention and remember the subject matter better, it can be assumed to be an important aspect. That humour can have a positive effect on the learning process has also been confirmed by other studies (Ulloth, 2002; Ziv, 2014). Furthermore, Ziv (2014) found that making use of humour can even lead to better examination results. In addition, it contributes to establishing a good relationship with the students (Ulloth, 2002). It would therefore be beneficial if faculty development programmes took account of the use of humour in education.

It also turns out that students find it important that a teacher has substantive knowledge about the subject in question. This information is relevant to the recurring discussion in medical education as to whether instructors who are non-experts can fulfil the role of facilitator (Davis et al., 1992; Neville, 1999). A related question is: what constitutes an expert teacher? Resources preclude the provision of all clinical education by specialists, but the question is whether, for example, a first-year resident is already a sufficiently qualified expert in a certain field. Beyond this, research by van den Berg et al. (2013) shows that teaching in their own specialism is a motivating factor for medical teachers. This is also in line with a survey among medical teachers into the qualities of an effective teacher. Of the top 3 qualities, "knowledge of subject" comes first, followed by enthusiasm and communication skills (Singh et al., 2013).

As a quality assurance method, our chosen approach, in which the students themselves evaluate which teachers they consider to be good and why, has a number of advantages. It does not lead to evaluation fatigue, unlike methods in which all teachers have to be assessed. The approach is relatively easy to implement and can be tailored to different educational programmes. The teachers receive personal feedback, which is formulated in the students' own words. For the teachers, it is motivating and

stimulating. A medical school can, for instance, engage these teachers for the further development of their education programmes. They can, for example, obtain a role in mentoring or faculty development programmes or be rewarded with access to teaching scholar programmes (Irby et al., 2004). However, the method also has a number of disadvantages. Because the students themselves arrive at their own formulations, it is not always clear what exactly they mean (for example: "he is a good teacher"). We have noticed that the students did not always know the names of the teachers, which also fits in with research by Uijtdehaage & O'Neal (2015). Students used descriptions such as "that bald man" or "that pregnant woman". It was not in all cases clear which teacher they were describing. In our experience, this occurred most often if the evaluations had to be completed on paper immediately after an exam. For evaluations that students could complete online at a later time, this was much less of a problem. Apparently, the students then made the effort to look up the name of the teacher. An important disadvantage of this method is that only some of the teachers receive feedback. One option is to ask the students which teachers they do not value. This would force us to think carefully about who would receive this information and how the teachers would be guided in dealing with negative feedback (Lutovac et al., 2017). Any demotivating effect this might have should be avoided, e.g. by means of meetings of course coordinators with teachers or by paying attention to dealing with student feedback in faculty development courses.

The principal strengths of this research are that it is based on the students' own formulations and the number of comments analysed. In describing the categories, we followed the students' formulations as precisely as possible and therefore distinguished, for example, between "clarity" and "good structure", although a certain degree of interpretation cannot be ruled out completely. By comparing the results to existing frameworks, we have demonstrated that student feedback is a valid source of information about teaching quality. A limitation is that it concerns the opinions of students at a single medical school. Because the preclinical phase is arranged in a similar way in many medical schools (Brauer & Ferguson, 2015), the results are likely to be useful for other medical schools as well. Another possible limitation is a possible bias among the students who participated in this evaluation, for example based on interest in the subject (Benton & Cashin, 2011). However, as the study covers 30 courses on several topics over three years of medical school and an average of almost 100 students per course answered the question, the effects of this possible bias on the overall results are likely to be limited. Furthermore, this bias will most likely occur if students are given a list of teachers to evaluate, which we did not do in this study. We asked the students which teachers stood out in a positive way. It seems that students make judgements about form rather than content, taking content as given. It is also notable that students often mention lecturers who can explain a complicated subject well, for instance: "*it was a difficult topic but still she managed to keep the*

whole audience fascinated for two lectures about a not very accessible subject, which is also beyond the scope of most students". Because the students' comments relate to all types of education, the results give a good picture of the total breadth of medical education (e.g. lectures, seminars, practical training). A possible disadvantage of this approach is that we do not know if and which qualities are particularly relevant for a certain type of education. That would be an interesting question for possible follow-up research.

This research into valued teaching qualities in the preclinical phase of medical school training is a valuable addition to research into teacher qualities in general (Feldman, 1976; Marsh, 2007) and in clinical teaching in particular (Burgess et al., 2016; Gibson et al., 2019). Our results can be used to optimise the limited time available to medical teachers for developing pedagogical expertise; for example, to determine the content of faculty development or teaching scholars programmes or to provide targeted feedback after observations (Irby et al., 2004; Kreber, 2002). Several of the more technical themes from the top 10, such as good explanation, good structure and clarity, generally receive attention in faculty development programmes (Steinert et al., 2016). Other topics, such as enthusiasm and the use of humour, may deserve more attention.

Despite the special context in medical training, the results of this research project are also relevant to other higher education programmes. As indicated in the introduction, medical students are generally motivated for and critical towards their education. It is therefore that their opinions and experiences can also be of interest to teachers and administrators from other higher education programmes. This information could also be applied in other fields of education, for example, to the development of teacher training courses and evaluation forms. In addition, medical training has a number of qualities that have been increasingly applied in other university programmes in recent years. An important feature of medical training is the direct link between training and professional practice. Factors in this are the large number of clerkships in clinical practice and also the fact that the teachers are mainly physicians. Nowadays, also in other study programmes, many longer and shorter traineeships are scheduled. In addition, more teaching is provided by (guest) teachers who also work in professional practice (Beaton & Gilbert, 2013). For these teachers, too, teaching is not their main task and they have limited time to professionalise in this area. This development is partly due to the so-called "Dublin Descriptors", a framework for Qualifications of the European Higher Education Area (European Consortium for Accreditation, 2020). An important aspect of this framework concerns the direct relationship with professional practice, which enables students to apply their acquired knowledge in practice. In addition to the students' assessments, the medical school can of course also decide that other factors are important. For example, students did not seem to consider interaction important, but for educational reasons, it may nevertheless be decided that

education should be more interactive, and in that case this should also be addressed in the faculty development programmes.

We can conclude that analysing evaluation data can provide valuable research information. Possible follow-up research projects could investigate whether students at different stages of the curriculum mention different aspects and which qualities of supervisors in the practical phase of the medical training are particularly valued. In this clinical phase, in addition to teaching knowledge and skills, the teachers are also role models for the students. A literature review (Jochemsen-van der Leeuw et al., 2013) shows that relevant qualities of clinical teachers as role models can be divided into three categories: patient care qualities, teaching qualities and personal qualities. It would be interesting to examine students' opinions in this area and why they consider certain teachers to be positive role models. This information would also be relevant for the supervisors of traineeships in other disciplines.

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References

Beaton, F., & Gilbert, A. (2013). *Developing effective part-time teachers in higher education. New approaches to professional development*. New York: Routledge.

Benton, S. L., & Cashin, W. E. (2011). *Student ratings of teaching: a summary of research and literature.* (Idea Paper 50) The Idea Center.

Beran, T. N., & Rokosh, J. L. (2009). Instructors' perspectives on the utility of student ratings of instruction. *Instructional Science*, *37*(2), 171–184. DOI: 10.1007/s11251-007-9045-2

van den Berg, B. A.M, Bakker, A. B., & ten Cate T. J. (2013). Key factors in work engagement and job motivation of teaching faculty at a university medical centre. *Perspectives on Medical Education, 2*(5–6), 264–275. DOI 10.1007/s40037-013-0080-1

Boeije, H. (2005). *Analyseren in kwalitatief onderzoek – denken en doen*. Amsterdam: Boom Onderwijs.[in Dutch]

Brauer, D. G., & Ferguson, K. J. (2015). The integrated curriculum in medical education. AMEE Guide No. 96. *Medical Teacher*, *37*(4), 312–322.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. DOI: 10.1191/1478088706qp063oa

van Bruggen, L., ten Cate, O., & Chen, H.C. (2020). Developing a Novel 4-C Framework to enhance participation in faculty development. *Teaching and Learning in Medicine, 32*(4), 371–379. DOI: 10.1080/10401334.2020.1742124

Burden, P. (2008). Does the use of end of semester evaluation forms represent teachers' views of teaching in a tertiary education context in Japan? *Teaching and Teacher Education*, *24*(6), 1463–1475. DOI: 10.1016/j.tate.2007.11.012

Burgess, A., Oates, K., & Goulston, K. (2016). Role modelling in medical education: the importance of teaching skills. *The Clinical Teacher, 13*(2), 134–137. DOI: 10.1111/tct.12397

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education*, *18*(8), 947–967.

Davis, W.K., Nairn, R., Paine, M.E., Anderson, R.M., & Oh, M.S. (1992). Effects of expert and non-expert facilitators on the small-group process and on student performance. *Academic Medicine*, *67*(7), 470–474.

European Consortium for Accreditation. (2020). Retrieved 08.12.2020 from http://ecahe.eu/w/index.php?title=Framework_for_Qualifications_of_the_European_Higher_Education_Area

Feldman, K.A. (1976). The superior college teacher from the students' view. *Research in Higher Education*, *5*(3), 243–288. DOI: 10.1007/BF00991967

Gibson, S.J., Porter, J., Anderson, A., Bryce A., Dart, J., Kellow, N. … Palermo, C. (2019). Clinical Educators' skills and qualities in allied health: a systematic review. *Medical Education*, *53*(3), 432–442. DOI: 10.1111/medu.13782

Guskey, T.R. (2002). Professional development and teacher change. *Teachers and Teaching*, *8*(3), 381–391. DOI: 10.1080/135406002100000512

Hoban, G., & Hastings, G. (2006). Developing different forms of student feedback to promote teacher reflection: A 10-year collaboration. *Teaching and Teacher Education*, *22*(8), 1006–1019. DOI:10.1016/j.tate.2006.04.006

Hwang, J.E., Kim, N.J., Song, M., Cui, Y., Kim, E.J., Park, I.A. … Kim, S.Y. (2017). Individual class evaluation and effective teaching characteristics in integrated curricula. *BMC Medical Education*, *17*(1), 252. DOI :10.1186/s12909-017-1097-7

Irby, D.M., Cooke, M. Lowenstein, D., & Richards, B. (2004). The academy movement: a structural approach to reinvigorating the educational mission. *Academic Medicine*, *79*(7), 729–736.

Jochemsen-van der Leeuw, H.G.A.R, van Dijk, N., van Etten-Jamaludin, F.S., & Wieringa-de Waard, M. (2013). The attributes of the clinical trainer as a role model: a systematic review. *Academic Medicine*, *88*(1), 26–34.

Knol, M. H., Dolan, C. V., Mellenbergh, G. J., & van der Maas, H. L. J. (2016). Measuring the quality of university lectures: development and validation of the Instructional Skills Questionnaire (ISQ). *PLoS One, 11*(2), e0149163. DOI:10.1371/journal.pone.0149163

Kreber, C. (2002). Teaching excellence, teaching expertise, and the scholarship of teaching. *Innovative Higher Education*, *27*(1), 5–23. DOI: 10.1023/A:1020464222360

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174.

Lutovac, S., Kaasila, R., Komulainen, J., & Maikkola, M. (2017). University lecturers' emotional responses to and coping with student feedback. A Finnish case study. *European Journal of Psychology education, 32*(2), 235–250. DOI: 10.1007/s10212-016-0301-1

Marsh, H. W., & Hocevar, D. (1991). The multidimensionality of students' evaluations of teaching effectiveness: The generality of factor structures across academic discipline, instructor level, and course level. *Teaching and teacher education*, *7*(1), 9–18.

Marsh, H. W. (2007). Students' evaluations of university teaching: dimensionality, reliability, validity, potential biases and usefulness. In R. P. Perry, & J. C. Smart (Eds.), *The scholarship of teaching and learning in higher education: An Evidence-based Perspective* (pp. 319–383). Oxford: Springer.

Melnick, D. E., Dillon, G. F., & Swanson, D. B. (2002). Medical licensing examinations in the United States. *Critical issues in Dental Education, 66*(5), 595–599.

Neville, A. J. (1999). The problem-based learning tutor: Teacher? Facilitator? Evaluator? *Medical Teacher*, *21*(4), 393–401. DOI: 10.1080/01421599979338

Nikendei, C., Krautter, M., Celebi, N., Obertacke U., & Jünger, J. (2012). Final year medical education in Germany. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen*, *106*(2), 75–84.

Patterson, F., Ferguson, E., & Zibarras, L. (2019). Selection into medical education and training. In T. Swanwick, K. Forrest, & B. C. O'Brien (Eds.), *Understanding Medical Education: evidence, theory and practice* (pp. 375–388). Oxford: Wiley Blackwell.

Schuwirth, L. W. T., & van der Vleuten, C. P. M. (2012). The use of progress testing. *Perspectives on Medical Education*, *1*(1), 24–30.

Singh S., Pai, D. R., Sinha, N. K., Kaur, A., Soe, H. H. K., & Barua, A. (2013). Qualities of an effective teacher: what do medical teachers think? *BMC Medical Education*, *13*(1), 128.

Steinert, Y., Mann, K., Anderson, B., Barnett, B. M., Centeno, A., Naismith, L. … Dolmans, D. (2016). A systematic review of faculty development initiatives designed to enhance teaching effectiveness: A 10-year update. BEME Guide No. 40. *Medical Teacher*, *38*(8), 769–786. DOI: 10.1080/0142159X.2016.1181851

Sutkin, G., Wagner, E., Harris, I., & Schiffer, R. (2008). What makes a good clinical teacher in medicine? A review of the literature. *Academic Medicine*, *83*(5), 452–466.

Uijtdehaage, S., & O'Neal, C. (2015). A curious case of the phantom professor: mindless teaching evaluations by medical students. *Medical Education*, *49*(9), 928–932. DOI: 10.1111/medu.12647.

Ulloth, J. K. (2002). The benefits of humour in nursing education. *Journal of Nursing Education*, *41*(11), 476–481. DOI: 10.3928/0148-4834-20021101-06

Wijnen-Meijer, M. Burdick, W., Alofs, L., Burgers, C., & ten Cate, O. (2013). Stages and transitions in medical education around the world: clarifying structures and terminology. *Medical Teacher*, *35*(4), 301–307.

Ziv, A. (2014). Teaching and learning with humour. *The journal of experimental education*, *57*(1), 4–15. DOI: 10.1080/00220973.1988.10806492

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Appendix

Table 1: Qualities of good teachers mentioned by the students

		amount	%
1	Good explanation	746	17.2
2	Clarity (in general)	573	13.2
3	Good pace	313	7.2
4	Good preparation	232	5.4
5	Enthusiasm (teacher)	223	5.2
6	Good structure	213	4.9
7	Enjoyable (of which 50 humour)	164	3.8
8	Stimulating/motivating (effect on students)	151	3.5
9	Knowledgeable	140	3.2
10	Instructive/informative	121	2.8
	Total Top 10	**2,876**	**66%**
11	Interesting/captivating	110	
12	Good teacher	96	
13	Good materials (powerpoints, pictures/figures, videos)	93	
14	Good examples (of which 47 practice examples)	83	
15	Possibility to ask questions	76	
16	Interactive lesson	74	
17	Gives proper answers to questions	67	
18	Easy to follow	65	
19	Tells you what you need to know/what is important	60	
20	Good use of voice	59	
21	Provides depth/challenge	58	
22	Manages group dynamics	57	
23	Engaged (interested in students)	51	
24	Ensures all students understand	51	
25	Stimulates students' thinking activites	49	
26	Kind/friendly	48	
27	Good course coordinator	39	
28	Good repetition/uses summaries	34	
29	Helpful	33	
30	To the point (no elaborating on unimportant topics)	31	
31	Pleasant atmosphere	30	
32	Gives extra (background) information	29	
33	Poses good/in-depth questions	26	
34	Reachable	26	
35	Well-told story	25	
36	Patient	23	
37	Comprehensive	18	
38	Useful/relevant	15	
39	Visualises information (for example using gestures)	14	
40	Approachable	12	
	Total	**4,328**	

Table 2: Qualities of good medical teachers – Top 10 explained

	Theme	Explanation	Quotes
1	Good explanation	The responses showed it was very important that a teacher explains the subject well – especially if the topic is complex.	*"He was also able to explain the complex physiology of the lungs well."* *"During the lectures, the complex topic was explained in a way that was understandable to the students."*
2	Clarity	The second theme, clarity, ties in with the first. Remarks were labelled with this theme, where "clarity" was not linked explicitly to explanation.	*"He is simply clear."* *"During the seminar he was very clear."* *"Teaching in a very nice and especially clear way"*
3	Good pace	Although some comments were about speeding up the pace, typical reactions were about steadiness of pace. In order to be able to follow a lecture well, it is important for students that the pace is not too fast.	*"Lectures at the right pace."* *"She did not rush."* *"Steady pace and easy to follow."*
4	Good preparation	The students express their appreciation of good preparation by the teacher.	*"This man deserves an award; he is always very well prepared."* *"She was well prepared and because of this I learned a lot."*
5	Enthusiasm	A substantial number of students indicate that enthusiasm in turn has a stimulating effect on students.	*"You can see that she is enjoying her work."* *"Her enthusiasm and passion is very compelling!"*
6	Good structure	Good structure helped students to understand the lesson.	*"His lectures were very well structured."* *"He starts at the beginning and then builds up step by step."*
7	Enjoyable (including humour)	In the seventh place was the theme "Enjoyable". Some students explicitly mention the use of humour.	*"The subject was explained with a lot of humour, which kept you very interested."* *"Really very enjoyable!"* *"I found her way of lecturing very enjoyable."*
8	Stimulating/ motivating	In eighth place students mentioned the fact that they felt stimulated/ motivated by the teacher.	*"A motivating way of lecturing."* *"[his enthusiasm] was contagious."* *"Really stimulated me."*
9	Knowledgeable	In 140 comments, the teacher's level of knowledge was mentioned.	*"She is very well informed about the subject."* *"He knew a lot about the seminar topics."*
10	Instructive/ informative	In 121 cases, a teacher was mentioned because students found the lesson instructive.	*"Lectures were very instructive."* *"The lecture gave me a lot of insight into the physiology of bone healing."* *"She taught me a lot."*

Table 3: Comparison top 10 themes with Feldman's categories, SEEQ Factors and results of the review of Sutkin et al.

	Themes	Feldman's categories	SEEQ Factors	Literature review Sutkin et al.
1	Good explanation	Clarity and understandableness (6)	Organisation/Clarity	Communication skills
2	Clarity (in general)	Clarity and understandableness (6)	Organisation/Clarity	Communication skills
3	Good pace	Elocutionary skills (7)	Workload/Difficulty	
4	Good preparation	Preparation and organisation (5)	Organisation/Clarity	
5	Enthusiasm (teacher)	Enthusiasm (2)	Instructor Enthusiasm	Enthusiasm
6	Good structure	Preparation and organisation (5)	Organisation/Clarity	
7	Enjoyable/humour		Instructor Enthusiasm	
8	Stimulating/motivating	Stimulation of interest (1)/Intellectual challenge (17)	Learning/Value	
9	Knowledgeable	Subject knowledge (3)/Intellectual expansiveness (4)	Breadth of coverage	Medical/clinical knowledge Clinical and technical skills/competence
10	Instructive/informative	Perceived outcome/impact (12)	Learning/Value	

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Considerations towards management competencies and their associations with becoming self-employed in a future career – a cross-sectional study with medical students in Germany

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Within the framework of medical education, the CanMEDS-competences, especially leadership, play an important role. This competence includes important aspects regarding practice management and entrepreneurial topics as these are essential for self-employed physicians. The aims were to evaluate considerations towards future work and to identify associations with self-employment from the perspective of medical students. The study was designed as an online survey. The online questionnaire was completed by 292 students. A high proportion of medical students would prefer to work in a team and supported that entrepreneurial issues should be integrated into the medical curriculum. The integration of entrepreneurial topics into the medical curriculum will be necessary to strengthen the future of outpatient care in order to lower entry barriers to self-employment. Furthermore, entrepreneurial knowledge about self-employment could have a positive influence on the medical profession in the future.

1 Background

In recent years, an extension of the physicians' role has been observable. The skills that a modern-day physician has to provide have increased both in complexity and diversity, from being a medical expert to being a leader/member of a health care team that governs cost, finance and human resources (Berkenbosch et al., 2014; Eisemann et al., 2018; Frank et al., 2015; O'Brien et al., 2018). In many countries, outpatient physicians are self-employed and thus, as small-scale entrepreneurs, those additional competencies increase (Groenewegen et al., 2002, S. 200–214). Competency-based medical education has become an integral part of medical education (Schütte & Rödder, 2017, pp. 117–141) and, in Europe, is also often based on the CanMEDS model developed by the Royal College of Physicians and Surgeons in Canada (Frank et al., 2015). This model was developed in the 1990s and contains physician competences exemplified by seven different roles: medical expert, communicator, collaborator, leader, health advocate, professional and scholar (Frank et al., 2015).

The aim of the medical educational curriculum is to provide students with evidence-based knowledge and clinical competences for treating patients. However, practice management issues play an important role for physicians who are working in outpatient care. Skills identified as being crucial for self-employment were knowledge of setting up a practice; business and administration; law; finance; finding the right support and attitudes towards planning security (Bar-Or, 2015; Halbert et al., 1988; Lazarus, 1995). Advantages that are offered by self-employment are a higher remuneration for self-employed physicians than that of the average employed physician (OECD, 2019) in combination with a relatively low risk of becoming insolvent in Germany (< 0.05%) (Statistisches Bundesamt, 2019), self-governance, a higher degree of freedom, independent decision-making, a high degree of satisfaction, compatibility of work and family and dissatisfaction with clinical routines in Germany (Koch et al., 2011; Steinhäuser et al., 2011). Despite these excellent contextual factors, the willingness to become self-employed continues to decline. In Germany, the proportion of employed physicians has increased over the last decade from 59.6% to 69.3% and could be an explanation for the low reoccupation rate for practices in Germany (Bundesärztekammer, 2018; Jacob et al., 2018).

It can be assumed that different stereotypes exist concerning self-employment from the perspective of medical students, which could have an impact for the recruitment of physicians in the future. Moreover, for medical students it is important beside evidence-based knowledge and clinical competences to know what kind of aspects such as contextual factors are relevant to work as a physician and could provide information for the extension of the content of the medical educational curriculum in terms of practice management and self-employment.

Therefore, the aims of the current study were to evaluate considerations towards future work and to identify factors which medical students associate with self-employment. Our research questions were: How would medical students like to work in the future? What kind of role do entrepreneurial issues play in their future work? Which aspects would influence them to consider working on a self-employed basis?

2 Methods

2.1 Design and participants

The study was carried out according to the STROBE-Guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) (von Elm et al., 2007). The study was designed as a cross-sectional survey including all medical students from two medical schools in Germany which were located in the south and the north of Germany. All students from these two medical schools were invited by their student body to

participate in an online survey between January and February 2015 independent of age, gender and years of academic study.

2.2 Measurement

A questionnaire was developed on the basis of preliminary studies with medical students and resident physicians as well as a focus group with participants from different occupational backgrounds (medical students, resident physicians, physicians, health services researchers and health-care managers) (Kiolbassa et al., 2011; Kohlhaas et al., 2017; 2018; Steinhäuser et al., 2011; 2013). Different topics were identified and considered in the questionnaire. The questionnaire was not validated. One topic of the self-developed questionnaire was the evaluation of considerations of medical students towards different aspects of their future work which were divided into ideas of prospective work situation; knowledge transfer of entrepreneurial topics; and capacity and support. These different aspects were measured using 15 items. Each item was rated on a 5-point Likert scale ranging from 1 (fully agree) to 5 (fully disagree). A second topic was the evaluation of the skills needed for self-employment and planning security which were divided into skills for self-employment; support for self-employment; and attitudes towards planning security. These different aspects were measured using 13 items. Each item was rated on a 5-point Likert scale ranging from 1 (fully agree) to 5 (fully disagree). Sociodemographic aspects of the medical students were measured, such as gender, age and number of semesters.

2.3 Data analysis

Analyses were performed using SPSS 24.0 (SPSS Inc., IBM). Continuous data were summarised using means and standard deviations. Categorical data were presented as frequency counts and percentages. A descriptive analysis of the two topics and the related items was conducted. The means, standard deviations (*SD*) and confidence intervals of each item were reported. Internal consistency for each scale was assessed using Cronbach's alpha, which indicates whether an item of a scale is appropriate for assessing the underlying concept of the scale (Cronbach, 1951). Values for Cronbach's alpha range from 0 to 1. The closer they are to 0, the less related the items are to one another. Values above 0.60 are generally considered to indicate satisfactory internal consistency. Spearman rho correlation was used to select the independent variables from characteristics of the study population, the questions about considerations of medical students towards different aspects of their future work; and the questions regarding skills for self-employment and planning security from the perspective of medical students. Variables that showed a significant correlation with the dependent variables "the intention of becoming self-employed" and "considering working as an employee" were included in the linear regression analyses. These were used to explore

potential multivariate associations between the dependent variables "the intention of becoming self-employed" and "considering working as an employee" and the previously selected independent variables. Additionally, the possibility of multicollinearity was considered. The variance inflation factor (VIF) and the value of tolerance were reported for each of the regression models. Values of VIF should not be over 5.0 and for tolerance not lower than 0.25 (Field, 2011). The incidence of missing data (< 10%) was negligible for the data analysis. An alpha level of $p < 0.05$ was used for tests of statistical significance.

2.4 Ethics approval and consent to participate

The ethics committee of the Heidelberg Medical School informed us that approval by an ethics committee was not necessary for a study which does not involve patient data. Anonymity of the participating students and data security were ensured. The return of the anonymous paper-based questionnaire was classified as informed consent.

3 Results

The online questionnaire was answered by 292 students. Table 1 describes the characteristics of the sample. Over 53% of the study population was female. The mean age of the participants was 24.1 years (*SD* = 3.38).

Table 1: Sociodemographic data of participants (n = 292)

Variables*		
Gender	Male	114 (39.00%)
	Female	155 (53.10%)
Age, mean (*SD*)		24.10 (3.38)
Number of semesters, mean (*SD*); min/max		7.54 (3.34); 2/12

* n varies due to missing data; *SD* standard deviation.

The different items for the topic "considerations of medical students to different aspects of future work" are presented in Table 2. It was observed that a high proportion of medical students placed great value on collegial exchange (89.40%) and would prefer to work in a team (71.60%). A lower percentage of medical students would prefer to work as an employee (14.00%) or becoming self-employed (17.80%). The listed mean value of the different items for considerations to different aspects of their future work in Table 2 shows that medical students fully agreed about the item "I attach great importance to collegial exchange" with a mean value of 1.70 (*SD* = 0.72). A lower agreement was found for the item "I can imagine my professional future as an employee" with a mean value of 3.69 (*SD* = 1.11). The section about the knowledge

transfer of entrepreneurial issues showed high agreement for integrating entrepreneurial issues into the training of health professionals with a mean value of 1.93 (*SD* = 0.93). The section on capacity and support showed high agreement for all three items. These were "I feel physically equipped for self-employment" (mean = 1.61 (*SD* = 0.63)), "I feel psychologically equipped for self-employment" (mean = 1.78 (*SD* = 0.74)) and "I feel supported by my social environment" (mean = 1.47 (*SD* = 0.74)).

Table 2: Considerations of medical students to different aspects of future work – descriptive statistics (n = 292)

	Mean *(SD)**	95% *CI*
Thoughts on prospective working situation (α = 0.52)		
I intend to become self-employed.	2.57 (0.98)	2.45–2.68
I can imagine my professional future as an employee.	3.69 (1.11)	3.56–3.82
I would like to keep my professional development completely open over the next few years.	2.09 (0.92)	1.98–2.20
The entrepreneurial risk entailed in self-employment discourages me.	3.01 (1.17)	2.87–3.14
I attach great importance to collegial exchange.	1.70 (0.72)	1.61–1.78
I attach great importance to working in a team.	2.02 (0.91)	1.92–2.13
I would like my future work to be cooperative in some way.	2.39 (0.86)	2.29–2.49
Knowledge transfer of entrepreneurial issues (α = 0.59)		
Entrepreneurial issues should be integrated into the training of health professionals.	1.93 (0.93)	1.83–2.04
I could imagine gaining knowledge through a business game.	2.46 (1.06)	2.34–2.58
I am willing to acquire basic business knowledge.	2.01 (0.78)	1.92–2.11
Capacity and support (α = 0.77)		
I feel psychologically equipped for self-employment.	1.78 (0.74)	1.69–1.86
I feel physically equipped for self-employment.	1.61 (0.63)	1.54–1.68
I feel psychologically equipped for an employed activity.	1.78 (0.75)	1.69–1.86
I feel physically equipped for an employed activity.	1.67 (0.69)	1.59–1.75
I feel supported by my social environment (family, friends).	1.47 (0.74)	1.39–1.56

SD standard deviation; *CI*, confidence interval; α Cronbach's alpha.
* Ranges from 1 "fully agree" to 5 "fully disagree".

The different items of the topic "skills for self-employment and planning security from the perspective of medical students" are shown in Table 3. The section about skills for self-employment had lower scores of agreement in all four items, especially the item "I have knowledge of the legal framework (e.g. labour law)" (mean = 4.45 (*SD* = 0.75)). The section about support for self-employed people showed high agreement between the different groups regarding who could provide support to self-employed medical professionals. As an example, a mean value of 1.64 (*SD* = 0.74) was found for "tax consultant". The section about attitudes to planning security

showed the highest agreement for "financial planning" and "job security", with mean values of 1.65 (*SD* = 0.60 resp. *SD* = 0.73) each.

Table 3: Skills for self-employment and planning security from the perspective of medical students – descriptive statistics (n = 292)

	Mean *(SD)**	95% *CI*
Skills for self-employment (α = 0.75)		
I consider my knowledge of setting up a practice to be sufficient.	4.35 (0.79)	4.25–4.44
I have a knowledge of business administration.	4.22 (0.96)	4.10–4.34
I have a knowledge of the legal framework (e.g. labour law).	4.45 (0.75)	4.35–4.54
I have a knowledge of finance (e.g. loans).	4.14 (0.92)	4.03–4.25
Support for self-employment (α = 0.66)		
A tax consultant	1.64 (0.74)	1.55–1.72
A lawyer	2.03 (0.94)	1.91–2.14
A bank	1.71 (0.72)	1.63–1.80
A specialist for setting up a practice	2.17 (1.03)	2.04–2.29
The family	1.82 (0.94)	1.70–1.93
Attitudes to planning security (α = 0.61)		
Financial planning	1.65 (0.60)	1.58–1.72
Job security	1.65 (0.73)	1.56–1.73
Work-life-balance	1.77 (0.81)	1.67–1.87
Taking a financially manageable risk	1.81 (0.73)	1.72–1.89

SD standard deviation; *CI*, confidence interval; α Cronbach's alpha.
* Ranges from 1 "fully agree" to 5 "fully disagree".

Table 4 shows the linear regression analysis of the characteristics of the study population, the questions to considerations of medical students towards different aspects of their future work and the questions on skills for self-employment and planning security from the perspective of medical students which correlated significantly with the outcome variable "the intention of becoming self-employed". A model with an explained variance with more than 42% (R^2 ~ 0.43) on the outcome variable "the intention of becoming self-employed" was carried out. The higher agreement with the intention of becoming self-employed was associated with higher agreement that entrepreneurial issues should be integrated into the training of health professionals, the opportunity for knowledge transfer through a business game, and the willingness to acquire basic business knowledge. Moreover, higher agreement with the intention of becoming self-employed was associated with lower agreement with the intention of working as an employee in the future and that the entrepreneurial risks entailed in self-employment was discouraging. The statistics of collinearity ranged between 1.62 (VIF-value), 0.62 (tolerance value) for "I attach great importance to collegial exchange" and 1.03 (VIF-value), 0.97 (tolerance value) for "gender".

Table 4: Associations of characteristics of the study population, considerations of medical students to different aspects of future work and skills for self-employment and planning security on the outcome variable intention to become self-employed (results of linear regression analysis, under specification of standardised beta coefficient, α = 5%)

Variables	β (p-value)
Age	–0.10 (0.10)
Semesters	–0.02 (0.73)
Gender	0.09 (0.10)
I can imagine my professional future as an employee.	–0.30 (<0.01)
I would like to keep my professional development completely open over the next few years.	–0.18 (<0.01)
The entrepreneurial risk entailed in self-employment discourages me.	–0.18 (0.01)
I attach great importance to collegial exchange.	–0.05 (0.45)
I attach great importance to working in a team.	–0.06 (0.37)
Entrepreneurial issues should be integrated into the training of health professionals.	0.21 (<0.01)
I could imagine gaining knowledge through a business game.	0.15 (0.01)
I am willing to acquire basic business knowledge.	0.15 (0.01)
I feel psychologically equipped for self-employment.	0.01 (0.93)
I feel supported by my social environment (family, friends).	0.10 (0.07)
I have a knowledge of business administration.	0.09 (0.13)
R^2	**0.43**

Table 5 shows the linear regression analysis of the characteristics of the study population, the questions regarding the considerations of medical students towards different aspects of future work and the questions about skills for self-employment and planning security from the perspective of medical students which correlated significantly with the outcome variable "considering working as an employee". A model with an explained variance with more than 31% ($R^2 \sim 0.31$) on the outcome variable "considering working as an employee" was carried out. The higher agreement for considering working as an employee was significantly associated with higher agreement that "entrepreneurial risk entailed in self-employment is discouraging". Moreover, a higher agreement for considering working as an employee was significantly associated with lower agreement for the intention of becoming self-employed. The statistics of collinearity ranged between 1.45 (VIF-value), 0.69 (tolerance value) for "I intend to become self-employed" and 1.01 (VIF-value), 0.99 (tolerance value) for "gender".

Table 5: Associations of characteristics of the study population, consideration of medical students to different aspects of future work and planning security on the outcome variable imagine to work as an employee (results of linear regression analysis, under specification of standardised beta coefficient, $\alpha = 5\%$)

Variables	β (p-value)
Age	–0.09 (0.16)
Semesters	0.01 (0.85)
Gender	–0.01 (0.83)
I intend to become self-employed.	–0.36 (< 0.01)
The entrepreneurial risk entailed in self-employment discourages me.	0.26 (< 0.01)
Entrepreneurial issues should be integrated into the training of health professionals.	0.03 (0.61)
I could imagine gaining knowledge through a business game.	–0.07 (0.23)
I feel supported by my social environment (family, friends).	–0.05 (0.39)
R^2	**0.31**

4 Discussion

This study explored considerations to future work and identified associations with self-employment from two medical schools in Germany. Compared to the whole sample of medical students, no differences were found in terms of gender for our study population. Germany-wide there was a proportion of 38% male and 62% female medical students in the year 2018 and was nearly the same (39% male and 61% female) for the year of data collection 2015 (Statistisches Bundesamt, 2020). An acceptable internal consistency for the different subscales was observed.

Most of our participants preferred to work in a team, which is in accordance with research about this generation called Generation Y (Choi et al., 2013). They favour a team-oriented approach for their future working conditions (Choi et al., 2013; Solnet & Hood, 2008). Moreover, we observed that medical students preferred the ability to have professional exchanges with colleagues in their future careers. Colleagues are an important source of social support and could contribute to a reduction in pressure at work (Wallace & Lemaire, 2007).

Furthermore, our data show that it seems difficult for medical students to commit to whether they intend to work as an employee or to become self-employed in their future career. The career choice is influenced by different factors and a decision can be expected at the end of the studies or during the residency (Kiolbassa et al., 2011). Our results show that the intention to become self-employed is associated with the integration of entrepreneurial topics into the training and with the acquisition of basic business knowledge.

An international comparison shows that management competencies as a part of the CanMEDS framework need to be improved from the perspective of medical residents as well as medical students (Berkenbosch et al., 2013). This is in line with the rather low scores of agreement for the items that consider the skills for self-employment observed in our study. In general, offers of education in entrepreneurship at university departments positively affect students' self-employment intentions (Walter et al., 2013). However, usually these offers are concentrated on those participants that already have an entrepreneurial intention (Liñán et al., 2011). Many of the students may attempt to become self-employed even without taking any course. However, educational offers might encourage these students towards self-employment and to provide knowledge about specific steps to becoming self-employed successfully, e.g. developing a business plan (Honig, 2004). To increase the willingness to becoming self-employed among a broader range of medical students, educational content with entrepreneurial awareness aiming to change their belief systems about self-employment might be helpful (Fretschner & Weber, 2013). For instance, making students aware and interested in this career option. Therefore, it can be assumed that the integration of entrepreneurial topics is a useful educational tool within the medical curriculum. Different universities have already integrated business games as part of e-learning within their medical curricula. It was observed that computer-aided serious games can be a teaching tool for medical students to experience more about organisational and conceptual basics of medical practice (Hannig et al., 2012). Furthermore, a simulated physician assistant's first day in hospital was introduced by different universities in Germany and was rated as a useful tool in preparing medical students for their future professional life and to experience additional management competencies (Fürstenberg et al., 2018).

The perceived entrepreneurial risk of failure is found to be an inhibiting factor on the intention of becoming self-employed. This is in line with findings of other related studies considering students from other subjects (Fretschner & Weber, 2013; Nabi & Liñán, 2013). Wu and Knott (2006) find that entrepreneurs face two different kinds of risks: uncertainty regarding market demand (exogenous risks), and uncertainty regarding their own entrepreneurial ability (risks over which one believes to have some control). The former uncertainty might be reduced by providing information to the students about the positive environmental factors, e.g. the expected shortage of physicians (especially in rural areas) (Kopetsch, 2010; Steinhäuser et al., 2012) and the low risk of insolvency (Statistisches Bundesamt, 2019). To address the latter, it has been shown that including practice management skills and entrepreneurial issues within the medical curriculum may be useful in making them feel more confident about their own entrepreneurial ability (Crites & Schuster, 2004). Therefore, it can be assumed that the acquisition of these skills supports the reduction of the perceived entrepreneurial risk that is an inhibiting factor as observed in our results.

A promising tool for teaching entrepreneurial skills is the integration of simulation games within the medical curriculum that have proven to be useful in reducing uncertainty in abilities (Kohlhaas et al., 2017). Moreover, it has been shown that undergraduate nursing students benefit from the Friday Night at the ER simulation game concerning their complex problem solving strategies (Bacon et al., 2018). To deal with the complexity of health-care it is important to get adequate management competencies for future work in a health-care team.

4.1 Limitations

Our study does have some limitations. A basic limitation of our online survey was that we cannot calculate an exact response rate because it is not certain whether all medical students from the two medical schools had received the invitation to the survey by their student body. Due to data protection we received no access to the mailing list of the student body and therefore, we had no number of students who were invited to participate on the online survey. Furthermore, due to voluntary participation, a selection bias in favour of students more interested in the issue of self-employment and entrepreneurial aspects cannot be excluded. The developed questionnaire was not validated. Therefore, a further study should test the psychometric properties in detail. As the study is based on a cross-sectional survey, we cannot conclude causality in the analysis. Therefore, generalisation of our findings is limited. In addition, this was an exploratory study; p values should be interpreted with care. Significant results might be due to chance and will need to be confirmed in further targeted studies.

4.2 Conclusions

We concluded that the integration of entrepreneurial issues into the medical curriculum will be necessary to strengthen the future of outpatient care in order to lower entry barriers to self-employment and enable service providers to acquire the skills and abilities to fulfil CanMEDS role as leaders. Moreover, entrepreneurial knowledge for self-employment could have a positive influence on the future medical profession and continue to play a decisive role in shaping outpatient medical care.

List of abbreviations

CI: confidence interval; *SD*: standard deviations; SPSS: Statistical package of social science; VIF: variance inflation factor

Competing interests

The authors declare that they have no competing interests.

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References

Bacon, C.T., Trent, P., & McCoy, T.P. (2018). Enhancing systems thinking for undergraduate nursing students using friday night at the ER. *J Nurs Educ*, *57*(11), 687–689.

Bar-Or, Y. (2015). Empowering physicians with financial literacy. *J Med Pract Manage*, *31*(1), 46–49.

Berkenbosch, L., Muijtjens, A.M., Zimmermann, L.J., Heyligers, I.C., Scherpbier, A.J., & Busari J.O. (2014). A pilot study of a practice management training module for medical residents. *BMC Med Educ*, *14*(1), 107.

Berkenbosch, L., Schoenmaker, S.G., Ahern, S., Søjnæs, Snell, L., Scherpbier, A.J.J.A., & Busari, J.O. (2013). Medical residents' perceptions of their competencies and training needs in health care management: an international comparison. *BMC Med Educ*, *13*(1), 25.

Bundesärztekammer. (2018). Ärztestatistik zum 31. Dezember 2017. Retrieved 26.07.2020 from https://www.bundesaerztekammer.de/ueber-uns/aerztestatistik/aerztestatistik-2018/

Choi, Y.G., Kwon, J., & Kim, W. (2013). Effects of attitudes vs experience of workplace fun on employee behaviors. *Int J Contemp Hosp M, 25*(3), 410–427.

Crites, G.E., & Schuster, R.J. (2004). A preliminary report of an educational intervention in practice management. *BMC Med Educ*, *4*(1), 15.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334.

Eisemann, B. S., Wagner, R. D., & Reece E. M. (2018). Practical negotiation for medical professionals. *Semin Plast Surg, 32*(04), 166–171.

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gotzsche, P. C., & Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Ann Intern Med*, *147*(8), 573–577.

Field, A. (2011). *Discovering statistics using SPSS*. London: Sage Publications.

Frank, J. R., Snell, L., & Sherbino, J. (Eds.). (2015). *CanMEDS 2015 Physician Competency Framework*. Ottowa: Royal College of Physicians and Surgeons of Canada.

Fretschner, M., & Weber, S. (2013). Measuring and understanding the effects of entrepreneurial awareness education. *J Small Bus Manage*, *51*(3), 410–428.

Fürstenberg, S., Prediger, S., Kadmon, M., Berberat, P. O., & Harendza, S. (2018). Perceived strain of undergraduate medical students during a simulated first day of residency. *BMC Med Educ*, *18*(1), 322.

Groenewegen, P., Dixon, J., & Boerma, W. G. W. (2002). The regulatory environment of general practice: an international perspective. In R. B. Saltman, R. Busse, & E. Mossialos (Eds.), *Regulating entrepreneurial behaviour in European health care systems* (pp. 200–214). Open University Press.

Halbert, R. J., Bokor, A., Castrence-Nazareno, R., Parkinson, M. D., & Lewis, C. E. (1988). Competencies for population-based clinical managers: a survey of managed care medical directors. *Am J Prev Med*, *15*(1), 65–70.

Hannig, A., Kuth, N., Özman, M., Jonas, S., & Spreckelsen, C. (2012). eMedOffice: A web-based collaborative serious game for teaching optimal design of a medical practice. *BMC Med Educ, 12*(1), 104.

Honig, B. (2004). Entrepreneurship education: Toward a model of contingency-based business planning. *Acad Manag Learn Educ, 3*(3), 258–273.

Jacob, R., Kopp, J., & Schultz, S. (2018). *Berufsmonitoring Medizinstudenten.* Retrieved 26.07.2020 from https://www.kbv.de/html/5724.php.

Kiolbassa, K., Miksch, A., Hermann, K., Loh, A., Szecsenyi, J., Joos, S., & Goetz, K. (2011). Becoming a general practitioner which factors have most impact on career choice of medical students? *BMC Fam Pract, 12*(1), 25.

Koch, K., Miksch, A., Schürmann, C., Joos, S., & Sawicki, P. T. (2011). The German health care system in international comparison: the primary care physicians' perspective. *Dtsch Arztebl Int*, *108*(15), 255–261.

Kohlhaas, A., Götz, K., Berger, S., Mahler, C., Högsdal, N., & Steinhäuser, J. (2017). [Development of a simulation game for teaching entrepreneurial skills to novice health professionals in an interprofessional learning environment]. *Z Allg Med*, *93*(9), 362–369. [Article in German]

Kohlhaas, A., Leibner, M., Binder, T., Schütz, J., Zwierlein, R., & Steinhäuser, J. (2018). [Studying practice management via serious games – which knowledge should be conveyed?] *Z Allg Med*, *94*(1), 29–34. [Article in German]

Kopetsch, T. (2010). *[The German healthcare system is running out of physicians! A study on age structure and development of the number of physicians]*. Berlin: Bundesärztekammer und Kassenärztliche Bundesvereinigung. [Article in German]

Lazarus, A. (1995). From stethoscope to spreadsheet: The physician with an M.B.A. *Pharos Alpha Omega Alpha Honor Med Soc*, *58*(2), 20–23.

Liñán, F., Rodríguez-Cohard, J.C., & Rueda-Cantuche, J.M. (2011). Factors affecting entrepreneurial intention levels: a role for education. *Int Entrep Manag J*, *7*(2), 195–218.

Nabi, G., & Liñán, F. (2013). Considering business start-up in recession time: The role of risk perception and economic context in shaping the entrepreneurial intent. *International Journal of Entrepreneurial Behavior & Research, 19*(6), 633–655.

O'Brien, A., Etheridge, L., Ibison, J., & Reid, A.M. (2018). Teaching clinical leadership to medical students. *Clin Teach*, *15*(1), 506–508.

OECD. (2019). *Health at a Glance 2019.* Retrieved 26.07.2020 from https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2019_4dd50c09-en

Schütte, M., & Rödder, S. (2017). Management, Unternehmensführung, Organisation und Planung im ambulanten Sektor. In C. Thielscher (Ed.), *Medizinökonomie, Unternehmerische Praxis und Methodik* (Vol. 2, pp. 117–141). Wiesbaden: Springer Gabler.

Solnet, D., & Hood, A. (2008). Generation Y as hospitality employees: framing a research agenda. *J Hosp Manage Tourism, 15*(1–2), 59–68.

Statistisches Bundesamt. (2019). *Unternehmen und Arbeitsstätten: Insolvenzverfahren, September 2019.* Retrieved 26.07.2020 from https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Unternehmen/Gewerbemeldungen-Insolvenzen/Publikationen/Downloads-Insolvenzen/insolvenzen-2020410191094.html

Statistisches Bundesamt. (2020). *Bildung Forschung und Kultur: Hochschulen, Tabellen, Studierende: Deutschland, Semester, Nationalität, Geschlecht, Studienfach*. Retrieved 26.07.2020 from https://www-genesis.destatis.de/genesis/online?sequenz=tabelleErgebnis&selectionname=21311-0003#abreadcrumb

Steinhäuser, J., Annan, N., Roos, M., Szecsenyi, J., & Joos S. (2011). [Approaches to reduce shortage of general practitioners in rural areas – results of an online survey of trainee doctors]. *Dtsch Med Wochenschr*, *136*(37), 1715–1719. [Article in German]

Steinhäuser, J., Joos, S., Szecsenyi, J., & Götz K. (2013). [Which factors increase the perception of settling a family practice in rural areas?] *Z Allg Med*, *89*(1), 10–15. [Article in German]

Steinhäuser, J., Scheidt, L., Szecsenyi, J., Götz, K., & Joos S. (2012). [Perceptions of the local government about the primary care physicians shortage – a survey among mayors in the Federal State of Baden-Wuerttemberg]. *Gesundheitswesen, 74*(10), 612–617. [Article in German]

Wallace, J. E., & Lemaire, J. (2007). On physician well being – You'll get by with a little help from your friends. *Soc Sci Med*, *64*(12), 2565–2577.

Walter, S. G., Parboteeah, K. P., & Walter, A. (2013). University departments and self-employment intentions of business students: a cross-level analysis. *Entrepreneurship: Theory & Practice, 37*(2), 175–200.

Wu, B., & Knott, A. M. (2006). Entrepreneurial risk and market entry. *Management Science 52*(9), 1315–1330.

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The effects of negative knowledge video training on medical students' non-technical skills in cardiopulmonary resuscitation

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Cardiopulmonary resuscitation (CPR) is a complex medical task that requires technical skills (TS) as well as non-technical skills (NTS). In medical education, CPR training focuses on teaching TS, although research has indicated that poor NTS are often the reason for medical errors. The aim of the present study was thus to investigate the effects of training on medical students' NTS performance. 80 medical students participated in an experimental design. The control group took part in traditional CPR training that focuses on TS. The experimental group participated in CPR training that addressed NTS and emphasised learning from errors. The results revealed significantly higher ratings in all NTS for the experimental group, indicating that NTS can be trained effectively. Using videos as instructional means to pinpoint errors in NTS increases students' CPR performance and they appear to learn from errors. A time-efficient intervention in medical education is enough to make a difference.

1 Introduction

Medical educators face the challenge of preparing their students for a complex clinical work environment in which they are able to deliver high-quality patient care. A study programme that primarily aims at the pure transfer of knowledge falls short of this mark, though. To keep up with dynamic changes in the field, ongoing political reforms aim to further develop and restructure medical education (Wissenschaftsrat, 2018). The Master Plan for Medical Studies 2020 (*Masterplan Medizinstudium 2020*) formulates strategic goals for improving medical education on a national level in Germany. According to this agenda, one key goal is to design more competence-based training to support the development of knowledge, skills and attitudes. Subsequently, greater emphasis is also placed on the non-technical skills (NTS; e.g. communicative and managerial skills) of future physicians, who often work in multidisciplinary and interprofessional teams. The German Association for Medical Education has also expressed the need for NTS in undergraduate education. Accordingly, a "learning objective catalogue for patient safety in undergraduate medical education" was published with the aim to unify curricular targets (Kiesewetter et al., 2016). Still, what should be taught in medical education and how to implement new instructional designs remain hotly debated topics (Wu & Busch, 2019).

Designing learning environments that improve medical students' competencies efficiently seems to be an important goal for curriculum development. However, only a few studies have investigated the effect of teaching NTS in undergraduate medical education (Moll-Khosrawi et al., 2019). As it is difficult to implement radical changes in medical curricula (Choi-Lundberg et al., 2020), an alternative approach was chosen in the present study. The basic idea was to take an existing course and add competence-oriented elements. We were interested in whether we can see improvements in NTS after only slightly adjusting a traditional training format.

CPR is a medical action everyone – from medical professionals to laypersons – should be able to perform. CPR is defined by guidelines – for example, those of the European Resuscitation Council (ERC; Perkins et al., 2018) – which show that CPR is a complex task comprising both technical skills (TS) and NTS. TS involve skills such as chest compressions, ventilation and the use of an automated external defibrillator (AED). NTS refer to human factors containing cognitive and mental processes, such as task management or situational awareness, as well as social and interpersonal skills like teamwork and communication within CPR to apply the correct treatment (Flin & Maran, 2015). The ERC emphasises that both TS and NTS are required for effective CPR. NTS complement and enhance TS. Research has also found positive correlations between the two skill types (Flin & Maran, 2016; von Wyl et al., 2009). Moreover, enhancing particular NTS can be beneficial to professionals' technical performance in a wide variety of medical domains (Hull et al., 2012).

1.1 Non-technical skills in cardiopulmonary resuscitation

Despite the importance of NTS, CPR training still mainly focuses on teaching technical performance without explicitly addressing NTS. Recent research shows that poor NTS are a significant cause of medical errors, and that insufficient NTS can lead to fatal medical accidents that harm patient safety and even cause patient death (Hinshaw, 2016; Monks & Maclennan, 2016; Odell, 2011; Truta et al., 2018). Improving these skills should reduce accidents (Uramatsu et al., 2017). Errors can happen from deficiencies in both TS (e.g. wrong drug administration) and NTS (e.g. bad communication), though. However, research shows that if errors occur in medical domains, they are more likely to happen due to insufficient non-technical performance. Most errors occur due to a lack of communication (Rovamo et al., 2015), wrong decision-making or a lack of situational awareness (Moorthy et al., 2005).

To investigate CPR performance, a reliable method that assesses both TS and NTS is required. While training dummies can be used to assess technical performance, assessing NTS is more challenging. NTS are usually latent skills and, depending on the respective medical domain, the skills physicians require can differ. For instance,

surgeons need different NTS (e.g. explicit task management and communication during surgery) than radiologists (e.g. situational awareness when looking at X-rays). In the last decade, instruments have been developed to assess physicians' NTS in different medical disciplines: for instance, NOTSS (to assess surgeons' NTS) and ANTS (to assess anaesthetists' NTS; Flin et al., 2010; Yule et al., 2006). In the case of CPR, skills like task management, teamwork and situational awareness are important for good CPR performance (Porter et al., 2018; Wieck et al., 2018).

Simulated scenarios are typically used as instructional means to train CPR. Simulations are common learning environments in medical education (Flentje et al., 2018; Kern et al., 2011; Langdorf et al., 2014). The unique characteristic of simulations in medical education is that the complexity of a task can be imitated so that it feels authentic (Burke et al., 2017; Flentje et al., 2018; McRae et al., 2017; Sadideen et al., 2017). With the help of a training dummy, students learn to apply their newly gained skills and can delve into the situation, thus enriching their understanding. The advantage of a simulation is that medical students can practise complex tasks without having to fear serious consequences for the patient. Errors happen, of course, but they can be used for training purposes when students learn to manage them.

One major challenge in medical education is the limitation of time for curriculum topics. Although Choi-Lundberg et al. (2020) show that it is possible to reduce teaching hours without much impact on student learning outcomes, it remains difficult to adjust curricula themselves. Due to time restrictions, the focus of CPR training lies on imparting relevant technical components, while intensive NTS training currently seems infeasible. Without training NTS explicitly, however, it is questionable whether students can appropriately master these skills later. Prior research especially notes poor NTS performance in the surgery and anaesthesia domains (Flin et al., 2010; Yule et al., 2006). To equip medical students with the relevant skills for their future professions, it is important to examine instructional means and their effects.

1.2 Negative knowledge: A favourable occasion to learn from errors in medical education CPR training

At the medical workplace, errors can have detrimental consequences for patient safety and should therefore be prevented. Avoiding errors in professional practice seems most evident, but designing instructional means that foster correct behaviour is less straightforward. Scholars have taken different approaches to learning and training. Bandura (1986) regards errors as obstacles to learning, which unnecessarily slow the learning process. In his social-cognitive theory, Bandura stresses that learners can reproduce an observed behaviour. Instead of costly and painful faulty efforts, he proposes direct informative guidance that focuses on the correct behaviour with the

help of a model. He also tells that reproduction is influenced by the learner's belief in his or her abilities to correctly execute that observed behaviour (Bandura, 2001).

However, as work activities are complex, there is a constant risk of something going wrong. Complex tasks are prone to errors, so it is common sense that errors cannot be completely avoided. Although errors endanger the attainment of desired goals, they are also a form of negative feedback, as they can indicate aspects that need further correction or refinement (Frese & Zapf, 1994; Gartmeier et al., 2008). When viewing errors as a form of feedback, this informative aspect can be used in learning. Gartmeier et al. (2008) describe learning from errors as a special form of experiential learning that plays a crucial role in professional development. Keith and Frese (2008) also take an explicitly positive view of errors for learning; in a meta-analysis, they investigate the effectiveness of a training method called error management training, in which errors are seen as a "*natural by-product of active learning*" (p. 59). Error management training is characterised by minimal guidance, active exploration and the explicit encouragement of making errors. Keith and Frese (2008) conclude that error management training is particularly effective for adaptive transfer tasks. Moreover, their meta-analysis revealed the positive effect of error management training, indicating that incorporating errors into training can be a more effective means of learning compared to training methods that focus on correct behaviours alone. Parviainen and Eriksson (2006) also recommend recognising the value of errors and failures as opportunities to learn. Similarly, Dyre et al. (2016) suggest exploring errors as learning in medical education rather than teaching error avoidance.

However, learning from errors is only possible if medical students are aware of errors and how to process them. They need to reflect on the causes and the effects, and understand how an error might be prevented next time. Thus, if students perceive an error as a critical event and consequently enrich and modify their knowledge base, they have learned. Trying to understand why errors occur and how best to prevent their repetition, Gartmeier et al. (2008) formulated the theory of negative knowledge. Negative knowledge is experiential knowledge about "*knowing what not to do*" (procedural aspect) and "*knowing what not to know*" (declarative aspect; Gartmeier et al., 2008). More precisely, negative knowledge means having awareness of one's competences and knowledge as well as acknowledging what one does not know. This includes knowing what not to do and acquiring skills to "unlearn" or "bracket" certain skills or knowledge that did not work in certain situations. Thus, practical experience within a specific (work) context can lead to obtaining negative knowledge. Errors provoke reflection and demand explanations, which results in interpreting situations differently (Gartmeier et al., 2015). Oser and Spychiger (2005) describe negative knowledge as a form of meta-knowledge, revealing a regulative impact on positive knowledge. In fact, negative knowledge is the outcome of learning from errors. It is

beneficial, as it provides certainty, improves efficiency and enhances the quality and depth of reflection. Knowing what is wrong in combination with the awareness of what can potentially go wrong is a heuristic advantage (Gartmeier et al., 2008).

Medical students do not necessarily need to make errors themselves to learn from them. It is also possible to demonstrate authentic case examples with virtual patients in which errors occur in real-life scenarios. Urresti-Gundlach et al. (2017) point out that virtual patients need to present a realistic image of the real world to ensure authenticity without overwhelming learners. Confronting medical students with a CPR performance that went wrong due to insufficient NTS might be an effective training method to increase awareness and improve their NTS, as long as they analyse the error's causes, develop more appropriate strategies and implement these new strategies accordingly. Positive and negative models can support the generalisation of the targeted behaviours (Baldwin, 1992) and enhance learning, as well as transfer of knowledge (Taylor et al., 2005). Negative knowledge offers the potential to understand how to better avoid errors, and should thus be developed more purposefully at the individual level (Gartmeier et al., 2010).

The aim of the present empirical study was to train medical students in cardiopulmonary resuscitation (CPR) and examine the influence of newly incorporated videos on their NTS. For that purpose, we compared two different training methods and their effects on medical students' NTS performance. An emphasis was put on addressing NTS by learning from errors. We therefore addressed the following research question: How do short "negative knowledge-based video lessons" incorporated in traditional CPR training affect medical students' NTS? Our hypothesis was that medical students show poorer NTS after traditional CPR training that focuses on TS, as compared to medical students who participate in slightly adjusted CPR training that also addresses NTS and encourages learning from errors.

2 Method

2.1 Design

We chose an experimental design with factor training (A versus B) and the dependent variables task management, teamwork and situational awareness. The sample was split into an experimental and a control group. The control group received traditional CPR training (training A). The experimental group received slightly adjusted CPR training with a focus on NTS (training B). To ensure that time-on-task was equal, in-depth TS lessons were added to training A. Age, gender and resuscitation knowledge were considered control variables to ensure that possible effects were attributable to the training.

2.2 Training

Training A was a traditional 2-week (4 hours per day) CPR training with a focus on TS that was standardised within the respective clinical hospital in Germany. It consisted of theoretical lessons about resuscitation according to ERC guidelines. In addition, the training contained practical lessons: for example, how to perform chest compression or intubation. The participants performed simulated CPR using dummies. After their within-training performance, the students discussed their task execution together with the teacher. During the debriefing, the teacher triggered reflection, pointed out mistakes and provided feedback. Overall, the training mostly addressed TS such as drug delivery, intubation, chest compression and defibrillation. On two days of the 2-week course (Wednesday of the first week and Thursday of the second week), additional TS training was provided in the form of theoretical input. The duration of these extra input sessions took 30 minutes each, and repeated the most important TS in the CPR course: chest compression, intubation and ventilation, as well as medication. Approximately one third of the total course time was spent on theoretical input, while two thirds was used for practical exercises and debriefing. NTS were not explicitly addressed in this training.

Training B was similar to training A in that it was a 2-week CPR course with a focus on TS, with theoretical and practical training parts. However, instead of additional TS training, the participants received additional NTS lessons. On Wednesday of the first week of the course, the NTS lesson was a 30-minute presentation about NTS and their impact on medical performance. On Thursday of the second week of the course, the NTS lesson was a 30-minute video-based NTS training that demonstrated errors that can happen during CPR due to insufficient NTS.

The video was created based on the theory of negative knowledge and according to recommendations by Guo et al. (2014). The video showed three people performing simulated CPR using a training dummy on the floor of a common hospital staffroom. This informal setting creates a personal feeling on the learners' sides, and is more engaging than a high-fidelity studio recording. The video lasted 10 minutes, as short videos were found to be more engaging than longer ones (Guo et al., 2014). The demonstrated scenario in the video was divided into three sequences that included nine different medical errors. These errors addressed task management, teamwork and situational awareness (three errors per skill). The following examples illustrate errors that occurred in the video: a) error in task management: the emergency doctor did not clearly distribute particular tasks (chest compression and preparing an AED) between his team members, which led to confusion and time loss; b) error in teamwork: important information like cardiac rhythm was not communicated, and ambiguous communication led to administering the wrong medication; and c) error in situational awareness: the emergency doctor did not recognise that one of his crew members had physical contact with the patient just before the AED was used.

The full video was presented once, then discussed by the participants among themselves and with their teacher. The discussion lasted 20 minutes. If necessary, sequences of the video were played again, and the teacher emphasised the role of NTS in the respective situations. The aim was to show the participants what they did not know themselves, as well as to enlighten them to what not to do in certain situations during CPR. At the end of this part of the training, the participants received take-home messages that summed up the most important facts about NTS performance during CPR.

2.3 Participants

The sample consisted of 80 medical students (39 females, 41 males), all enrolled in their third clinical semester of medicine. Participants were randomly assigned to one of two groups. 40 (20 females, 20 males) participants were assigned to training A, 40 participants (19 females, 21 males) were assigned to training B. Before entering their clinical semester, all medical students had attended a first aid course that included short CPR lessons. None of the participants had had any other prior resuscitation experience in their medical study programme.

2.4 Instruments

To assess NTS as well as demographic data and control variables, we developed a questionnaire and observation form.

Questionnaire: A demographic questionnaire gathered age, gender and knowledge concerning resuscitation. This data was collected to ensure that the participants did not differ regarding these variables.

Observation: We followed an open and non-participant observation procedure to measure the extent of NTS mastered during CPR training. The skills task management, teamwork and situational awareness were observed. Task management describes the emergency doctors' ability to radiate sovereignty and to ensure the best possible CPR procedure through clear instructions and by guiding their assistants if necessary. The student who had the role of the emergency doctor had to choose the method of treatment and arrange duties (e.g. "Gives instructions to arrange drug administration or defibrillation"). Teamwork describes the way the emergency doctor interacts with the assistants and manages the workload within the team (e.g. "Does not overtax the assistants"). Situational awareness describes the emergency doctor's awareness of the current situation and available resources, as well as the extent of re-evaluating the situation during the CPR process (e.g. "Gathers information about patient status").

We then developed an observation form that consisted of 28 items. A factor analysis including all items revealed three sets of items. These three sets corresponded to the NTS categories reported in the literature: task management, teamwork and situational awareness. Internal consistency (Cronbach's α) showed the following values: task management (11 items) α = .92, teamwork (10 items) α = .87 and situational awareness (7 items) α = .72. The different items corresponded to the ANTS behavioural marker system (Flin et al., 2010). The rating was also adopted from the ANTS system. The items were scored on a 4-point Likert scale (1 = *poor*, 2 = *marginal*, 3 = *acceptable*, 4 = *good*). According to the ANTS system, participants should at least score acceptable (3) in all items; otherwise, their NTS performance is considered weak. To ensure the quality of the rating process, the observers were trained to develop a shared understanding of the observation form. Then, four observers watched the videotapes separately and rated each student's behaviour independently, not knowing whether the participants had taken part in training A or training B. Cohen's kappa assessed the inter-rater reliability with a satisfying score of κ = .81.

2.5 Procedure

Data were collected during eight standardised 2-week CPR training courses at a university hospital. At the start of the course, the participants filled in the demographic questionnaire. They were randomly assigned to either the control (training A) or the experimental (training B) group. At the end of the training, all participants performed simulated CPR in teams of three. The participant who had the role of the emergency doctor was videotaped. This resulted in 80 different videos (40 for each training). These videos were analysed. Each video was approximately 15 minutes long, so that the total recording time was about 20 hours.

To minimise non-systematic influences, both trainers were actively involved in designing the training courses and planned the additional TS and NTS lessons carefully. The trainers used identical course materials and examples and were encouraged to synchronise their instruction.

2.6 Analysis

We used a statistics programme to analyse the data (SPSS 24, IBM, Armonk, USA). Descriptive analyses were performed for the dependent variables task management, teamwork and situational awareness. MANOVA was calculated to compare the two training groups regarding the dependent variables. The control variables were used to ensure that possible effects were attributable to the respective training.

3 Results

None of the control measures (age, gender, resuscitation knowledge) was significantly related to any of the NTS measures.

For participants who received training A, the descriptive statistics revealed the following mean scores: task management at $M = 2.99$, $SD = .45$; teamwork at $M = 2.49$, $SD = .47$; and situational awareness at $M = 2.31$, $SD = .47$.

For participants who took part in training B, the NTS scores were higher: task management was at $M = 3.50$, $SD = .37$; teamwork at $M = 3.21$, $SD = .27$; and situational awareness at $M = 2.82$, $SD = .42$. MANOVA showed that these differences were statistically significant ($F(3,76) = 24.73$, $p < .001$; *Wilk's* $\Lambda = .51$, partial $\eta^2 = .49$). After the negative knowledge lessons, NTS performance was significantly better in task management ($F(1,78) = 29.55$; $p < .001$; partial $\eta^2 = .28$), teamwork ($F(1,78) = 70.99$; $p < .001$; partial $\eta^2 = .48$) and situational awareness ($F(1,78) = 26.53$; $p < .001$; partial $\eta^2 = .25$).

4 Discussion and conclusion

In the present study, we compared traditional CPR training to an adjusted one, and investigated their effects on medical students' NTS performance. NTS lessons were integrated into an existing training programme by means of a time-efficient video-based intervention. Based on the theory of negative knowledge, we assumed that confronting medical students with errors due to NTS in CPR would raise their awareness that a lack of NTS can have severe consequences for patient safety. To date, only a few studies have investigated the effect of teaching NTS in undergraduate medical education (Moll-Khosrawi et al., 2019), and experimental designs in NTS training research are often missing (Hagemann et al., 2017). Ongoing political reforms stress the importance of implementing learning environments in medical education that foster the acquisition of knowledge, skills and attitudes (Wissenschaftsrat, 2018). The ERC emphasises the significant role of NTS in resuscitation in particular. Therefore, intervention studies that examine the effects of NTS training are relevant and help enhance the understanding of what instructional means can work under certain conditions.

We hypothesised that medical students show poorer NTS after traditional CPR training that focuses on TS, as compared to medical students who participate in CPR training featuring negative knowledge-based video lessons addressing NTS. Our study results confirmed our hypothesis. Medical students in the experimental group showed significantly higher NTS than students in the control group. All examined NTS – task management, teamwork and situational awareness – improved. Based on Cohen (1988) and Chen et al. (2010), the effect size for the CPR training with the negative knowledge-

based video lessons was large. A large effect size underlines the practical relevance of the found effects.

Accordingly, our study indicates that NTS can be trained effectively. As we were confronted with time restrictions, the training had to be kept to a minimum. The implementation of only a 30-minute theoretical input lesson, together with one short video and subsequent discussion, into CPR training already made a difference. Thus, 60 minutes, which we consider a feasible timeframe in medical education, led to changes in performance. It is important to note that this short period which had substantial effect, is part of a longer course and is not intended to replace the remaining course parts. The negative knowledge intervention may and should have effected other parts of the training and further practical work as well. It is beyond this study's scope to examine such effects. The finding is important for medical education, as the intervention can easily be added to existing courses and lead to better NTS performance. Hill et al. (2008) suggest comparing effect sizes with similar studies in the field. Accordingly, our results are in line with prior research. Hagemann et al. (2017) found in their experimental study that one brief seminar had positive effects on undergraduates' NTS. The intervention was a demonstration-based learning approach and lasted 90 minutes. Situational awareness, teamwork and decision-making improved significantly with effect sizes of $r = .50$, $r = .45$ and $r = .39$, respectively. Task management did not improve significantly.

Even if the results of our study are promising, some cautionary remarks should be considered. Although post hoc power analysis showed that our study had a power above .80, the effect sizes should be interpreted critically. We tried to standardise the setting as much as possible, but unsystematic influences caused by the teachers, students and group compositions cannot be ruled out completely. According to Ioannidis (2005) and Button et al. (2013), research findings are less likely to be true in the case of smaller sample sizes. Although our results were significant and revealed large effect sizes, there might be a risk of overestimating the true effect of the intervention. Therefore, an even larger sample size is desirable. However, feasibility also needs to be considered. In our study, 20 hours of video recordings were analysed, which was very time-consuming.

Another limitation of our study was that we only assessed student performance after their training programme. Testing their performance before, during and after training would help evaluate their performance more in depth. The focus in this study was on NTS and training NTS without measuring TS performance. To gain a better understanding of medical students' CPR performance in general, modern dummies can be used to allow the analysis of technical data, such as compression frequency or ventilation. Then, inferences about the impact of the CPR training regarding TS and NTS over time

can be drawn. Future research is needed to address the interplay between TS and NTS and investigate how they influence each other. Several studies have already indicated a close link between NTS and TS (Gostlow et al., 2017; Raison et al., 2018). This relation of skills might play an important role in understanding CPR performance as a whole and should be examined carefully.

In this study, we examined medical students who were still novices in the medical domain. Fostering their NTS competences early in medical education is considered important for their professional development (Wissenschaftsrat, 2018). In this respect, our study provides insightful information about early skill development. However, competence development regarding CPR is relevant at all stages of medical education. It is a medical task related to different medical disciplines, and even health professionals have to refresh their CPR knowledge and skills regularly. Future research can compare various professionals – such as persons who are likely to be involved and responsible in CPR – and examine how they apply TS and NTS. Furthermore, a longitudinal approach with several measurement points can reveal how TS and NTS are affected over time.

In conclusion, our study has some practical implications. The intervention was short, cost-efficient and certainly feasible to implement in a medical curriculum. The goal of the CPR training was for students to learn and apply CPR procedures correctly, and be able to transfer their knowledge and skills to an analogous task. For this purpose, direct instruction as proposed by Bandura (1986) on the one hand and instructional means that foster learning from errors (e.g. Gartmeier et al., 2008; Keith & Frese, 2005) on the other seem not necessarily conflicting approaches, but complementary. In our study, we used plenary sessions to present and discuss the video among students and their instructor. It seems, although short, that the negative knowledge examples triggered the students' NTS awareness. Training NTS via mobile devices might be an even more time-efficient method. Students could watch videos as preparation and actively reflect on the displayed errors. Engaging in the simulation and being responsible for their CPR performance afterwards seems an appropriate way to learn and practise such a complex task (Burke et al., 2017; McRae et al., 2017; Sadideen et al., 2017). However, research also indicates that it is necessary to be aware of what is wrong in professional practice (Dyre et al., 2016; Gartmeier et al., 2008; Gartmeier et al., 2015). Therefore, debriefing medical students after their performance should be an integrated part of CPR training, so as to create a community in which errors are discussed openly.

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References

Baldwin, T.T. (1992). Effects of alternative modeling strategies on outcomes of interpersonal-skills training. *Journal of Applied Psychology*, *77*(2), 147–154. https://doi.org/10.1037/0021-9010.77.2.147

Bandura, A. (1986). *Social foundations of thought and action. A social cognitive theory*. Prentice Hall.

Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology*, *3*(3), 265–299. https://doi.org/10.1207/S1532785XMEP0303_03

Burke, R.V., Demeter, N.E., Goodhue, C.J., Roesly, H., Rake, A., Young, L.C., Chang, T.P., Cleek, E., Morton, I., Upperman, J.S., & Jensen, A.R. (2017). Qualitative assessment of simulation-based training for pediatric trauma resuscitation. *Surgery*, *161*(5), 1357–1366. https://doi.org/10.1016/j.surg.2016.09.023

Button, K.S., Ioannidis, J.P.A., Mokrysz, C., Nosek, B.A., Flint, J., Robinson, E.S.J., & Munafiò, M.R. (2013). Power failure: Why small sample size undermines the reliability of neuro-science. *Nature Reviews Neuroscience*, *14*, 365–376. https://doi.org/10.1038/nrn3475

Chen, H., Cohen, P., & Chen, S. (2010) How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. *Communications in Statistics – Simulation and Computation*, *39*(4), 860–864. https://doi.org/10.1080/03610911003650383

Choi-Lundberg, D.L., Al-Aubaidy, H.A., Burgess, J.R., Clifford, C.A., Cuellar, W.A., Errey, J.A., Harper, A.J., Malley, R.C., Ross, R.M., Williams, A.-M.M., & Hays, R. (2020). Minimal effects of reduced teaching hours on undergraduate medical student learning outcomes and course evaluations. *Medical Teacher*, *42*(1), 58–65. https://doi.org/10.1080/0142159X.2019.1652258

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Erlbaum.

Dyre, L., Tabor, A., Ringsted, C., & Tolsgaard, M.G. (2016). Imperfect practice makes perfect: Error management training improves transfer of learning. *Medical Education*, *51*(2), 196–206. https://doi.org/10.1111/medu.13208

Flentje, M., Eismann, H., Sieg, L., Friedrich, L., & Breuer, G. (2018). Simulation als Fortbildungsmethode zur Professionalisierung von Teams [Simulation as a training method for the professionalization of teams]. *AINS – Anästhesiologie Intensivmedizin Notfallmedizin Schmerztherapie*, *53*(1), 20–33. https://doi.org/10.1055/s-0043-105261

Flin, R., & Maran, N. (2015). Basic concepts for crew resource management and non-technical skills. *Best Practice & Research Clinical Anaesthesiology*, *29*(1), 27–39. https://doi.org/10.1016/j.bpa.2015.02.002

Flin, R., & Maran, N. (2016). Non-technical skills: Identifying, training, and assessing safe behaviours. In R.H. Riley (Ed.), *Manual of simulation in healthcare* (2nd ed., pp. 249–264). Oxford University Press. https://doi.org/10.1093/med/9780198717621.003.0018

Flin, R., Patey, R., Glavin, R., & Maran, N. (2010). Anaesthetists' non-technical skills. *British Journal of Anaesthesia*, *105*(1), 38–44. https://doi.org/10.1093/bja/aeq134

Frese, M., & Zapf, D. (1994). Actions the core of work psychology: A German approach. In H.C. Triandis, M.D. Dunette, & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology* (Vol. 4, pp. 271–340). Consulting Psychologists Press.

Gartmeier, M., Bauer, J., Gruber, H., & Heid, H. (2008). Negative knowledge: Understanding professional learning and expertise. *Vocations & Learning*, *1*(2), 87–103. https://doi.org/10.1007/s12186-008-9006-1

Gartmeier, M., Bauer, J., Gruber, H., & Heid H. (2010). Workplace errors and negative knowledge in elder care nursing. *Human Resource Development International*, *13*(1), 5–25. https://doi.org/10.1080/13678861003589057

Gartmeier, M., Gruber, H., Hascher, T., & Heid, H. (Eds.). (2015). *Fortschritte in der Fehlerforschung. Fehler: Ihre Funktionen im Kontext individueller und gesellschaftlicher Entwicklung* [Errors: Their functions in context of individual and societal development]. Waxmann.

Gostlow, H., Marlow, N., Thomas, M.J.W., Hewett, P.J., Kiermeier, A., Babidge, W., Altree, M., Pena, G., & Maddern, G. (2017). Non-technical skills of surgical trainees and experienced surgeons. *British Journal of Surgery*, *104*(6), 777–785. https://doi.org/10.1002/bjs.10493

Guo, P.J., Kim, J., & Rubin, R. (2014). How video production affects student engagement: An empirical study of MOOC videos. In: *L@S '14, Proceedings of the First ACM Conference on Learning @ Scale Conference* (pp. 41–50). Association for Computing Machinery. https://doi.org/10.1145/2556325.2566239

Hagemann, V., Herbstreit, F., Kehren, C., Chittamadathil, J, Wolfertz, S., Dirkmann, D., Kluge, A., & Peters, J. (2017). Does teaching non-technical skills to medical students improve those skills and simulated patient outcome? *International Journal of Medical Education*, *8*, 101–113.

Hill, C., Bloom, H., Black, A., & Lipsey, M. (2008). Empirical benchmarks for interpreting effect sizes in research. *Child Development Perspectives*, *2*(3), 172–177. https://doi.org/10.1111/j.1750-8606.2008.00061.x

Hinshaw, K. (2016). Human factors in obstetrics and gynaecology. *Obstetrics, Gynaecology & Reproductive Medicine*, *26*(12), 368–370. https://doi.org/10.1016/j.ogrm.2016.09.002

Hull, L., Arora, S., Aggarwal, R., Darzi, A., Vincent, C., & Sevdalis, N. (2012). The impact of nontechnical skills on technical performance in surgery: A systematic review. *Journal of the American College of Surgeons*, *214*(2), 214–230. https://doi.org/10.1016/j.jamcollsurg.2011.10.016

Ioannidis, J.P.A. (2005). Why most published research findings are false. *Plos Medicine*, *2*(8), e124. https://doi.org/10.1371/journal.pmed.0020124

Keith, N., & Frese, M. (2008). Effectiveness of error management training: A meta-analysis. *Journal of Applied Psychology*, *93*(1), 59–69. https://doi.org/10.1037/0021-9010.93.1.59

Kern, D.H., Mainous, A.G., Carey, M., & Beddingfield, A. (2011). Simulation-based teaching to improve cardiovascular exam skills performance among third-year medical students. *Teaching and Learning in Medicine*, *23*(1), 15–20. https://doi.org/10.1080/10401334.2011.536753

Kiesewetter, J., Gutmann, J., Drossard, S., Salas, D.G., Prodinger, W., Mc Dermott, F., … Kiesewetter, I. (2016). The learning objective catalogue for patient safety in undergraduate medical education – a position statement of the Committee for Patient Safety and Error Management of the German Association for Medical Education. *GMS Journal for Medical Education*, *33*(1), Doc10, 1–7. https://doi.org/10.3205/zma001009

Langdorf, M.I., Strom, S.L., Yang, L., Canales, C., Anderson, C.L., Amin, A., & Lotfipour, S. (2014). High-fidelity simulation enhances ACLS training. *Teaching and Learning in Medicine*, *26*(3), 266–273. https://doi.org/10.1080/10401334.2014.910466

McRae, M.E., Chan, A., Hulett, R., Lee, A.J., & Coleman, B. (2017). The effectiveness of and satisfaction with high-fidelity simulation to teach cardiac surgical resuscitation skills to nurses. *Intensive and Critical Care Nursing*, *40*, 64–69. https://doi.org/10.1016/j.iccn.2016.11.001

Moll-Khosrawi, P., Kamphausen, A., Hampe, W., Schulte-Uentrop, L., Zimmermann, S., & Kubitz, J.C. (2019). Anaesthesiology students' non-technical skills: Development and evaluation of a behavioural marker system for students (AS-NTS). *BMC Medical Education*, *19*, 205. https://doi.org/10.1186/s12909-019-1609-8

Monks, S., & Maclennan, K. (2016). Human factors in obstetrics. *Anaesthesia & Intensive Care Medicine*, *17*(8), 400–403. https://doi.org/10.1016/j.mpaic.2016.05.014

Moorthy, K., Munz, Y., Adams, S., Pandey, V., & Darzi, A. (2005). A human factors analysis of technical and team skills among surgical trainees during procedural simulations in a simulated operating theatre. *Annals of Surgery*, *242*(5), 631–639. https://doi.org/10.1097/01.sla.0000186298.79308.a8

Odell, M. (2011). Human factors and patient safety: Changing roles in critical care. *Australian Critical Care*, *24*(4), 215–217. https://doi.org/10.1016/j.aucc.2011.02.001

Oser, F., & Spychiger, M. (2005). *Lernen ist schmerzhaft: Zur Theorie des negativen Wissens und zur Praxis der Fehlerkultur* [Learning is painful: To the theory of negative knowledge and to the practice of error culture]. Beltz.

Parviainen, J., & Eriksson, M. (2006). Negative knowledge, expertise and organisations. *International Journal of Management Concepts and Philosophy, 2*(2), 140–153. https://doi.org/10.1504/IJMCP.2006.010265

Perkins, G.D., Olasveengen, T.M., Maconochie, I., Soar, J., Wyllie, J., Greif, R., Lockey, A., Semeraro, F., van de Voorde, P., Lott, C., Monsieurs, K.G., & Volan, J.P. (2018). European Resuscitation Council guidelines for resuscitation: 2017 update. *Resuscitation*, *123*, 43–50. https://doi.org/10.1016/j.resuscitation.2017.12.007

Porter, J.E., Cant, R.P., & Cooper, S.J. (2018). Rating teams' non-technical skills in the emergency department: A qualitative study of nurses' experience. *International Emergency Nursing*, *38*, 15–20. https://doi.org/10.1016/j.ienj.2017.12.006

Raison, N., Ahmed, K., Abe, T., Bruckhorst, O., Novara, G., Buffi, N., McIlhenny, C., van der Poel, H., van Hemelrijck, M., Gavazzi, A., & Dasgupta, P. (2018). Cognitive training for technical and non-technical skills in robotic surgery: A randomised controlled trial. *British Journal of Urology International*, *122*(6), 1075–1081. https://doi.org/10.1111/bju.14376

Rovamo, L., Nurmi, E., Mattila, M.-M., Suominen, P., & Silvennoinen, M. (2015). Effect of a simulation-based workshop on multidisplinary teamwork of newborn emergencies: An intervention study. *BMC Research Notes*, *8*(1), 671–678. https://doi.org/10.1186/s13104-015-1654-2

Sadideen, H., Goutos, I., & Kneebone, R. (2017). Burns education: The emerging role of simulation for training healthcare professionals. *Burns*, *43*(1), 34–40. https://doi.org/10.1016/j.burns.2016.07.012

Taylor, P.J., Russ-Eft, D.F., & Chan, D.W.L. (2005). A meta-analytic review of behavior modeling training. *Journal of Applied Psychology*, *90*(4), 692–709. https://doi.org/10.1037/0021-9010.90.4.692

Truta, T.S., Boeriu, C.M., Copotoiu, S.-M., Petrisor, M., Turucz, E., Vatau, D., & Lazarovici, M. (2018). Improving nontechnical skills of an interprofessional emergency medical team through a one day crisis resource management training. *Medicine*, *97*(32), e11828. https://doi.org/10.1097/MD.0000000000011828

Uramatsu, M., Fujisawa, Y., Mizuno, S., Souma, T., Komatsubara, A., & Miki, T. (2017). Do failures in non-technical skills contribute to fatal medical accidents in Japan? A review of the 2010-2013 national accident reports. *BMJ Open*, *7*, e013678. https://doi.org/10.1136/bmjopen-2016-013678

Urresti-Gundlach, M., Tolks, D., Kiessling, C., Wagner-Menghin, M., Härtl, A., & Hege, I. (2017). Do virtual patients prepare medical students for the real world? Development and application of a framework to compare a virtual patient collection with population data. *BMC Medical Education*, *17*(1), 174–180. https://doi.org/10.1186/s12909-017-1013-1

Wieck, M.M., McLaughlin, C., Chang, T.P., Rake, A., Park, C., Lane, C., … Jensen, A.R. (2018). Self-assessment of team performance using T-NOTECHS in simulated

pediatric trauma resuscitation is not consistent with expert assessment. *The American Journal of Surgery*, *216*(3), 630–635. https://doi.org/10.1016/j.amjsurg.2018.01.010

Wissenschaftsrat. (2018). *Neustrukturierung des Medizinstudiums und Änderung der Approbationsordnung für Ärzte. Empfehlungen der Expertenkommission zum Masterplan Medizinstudium 2020*. Wissenschaftsrat.

Wu, A. W., & Busch, I. M. (2019). Patient safety: A new basic science for professional education. *GMS Journal for Medical Education*, *36*(2), Doc21, 1–7. https://doi.org/10.3205/zma001229

von Wyl, T., Zuercher, M., Amsler, F., Walter, B., & Ummenhofer, W. (2009). Technical and non-technical skills can be reliably assessed during paramedic simulation training. *Acta Anaesthesiologica Scandinavica*, *53*(1), 121–127. https://doi.org/10.1111/j.1399-6576.2008.01797.x

Yule, S., Flin, R., Paterson-Brown, S., Maran, N., & Rowley, D. (2006). Development of a rating system for surgeons' non-technical skills. *Medical Education*, *40*(11), 1098–1104. https://doi.org/10.1111/j.1365-2929.2006.02610.x

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Clinical decision-making in undergraduate surgical education. Exploring a TBL-course and the application of digital technologies

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Competence-based education in surgery needs to include diagnostic strategies, problem-solving skills and understanding of the indications in individual patients as well as learning of manual techniques. Upon completion of their training, students will need to know how to use these for the patients' benefit. We introduced Team-Based-Learning (TBL) in a large class format using digital teaching aids, to teach surgical patient management. Participants were introduced to digital tools increasingly common in clinical practice. Questionnaires, semi-structured interviews and focus groups investigated their effects and student perceptions. Students were highly satisfied with the course, were motivated and improved their surgical knowledge. The course generated a successful learning process in surgical patient management and improved students' confidence. Embedding future digital health technologies is welcomed and enhances students' activity but has to be introduced carefully.

1 Introduction

Competence-based undergraduate surgical education in Germany

In Germany, teaching surgical competencies is traditionally based on lectures and seminars. Lately, surgical curricula increasingly focus on teaching technical skills (Ruesseler et al., 2013). Competence-based education in surgery needs to go beyond this and should include diagnostic strategies, problem-solving techniques and an understanding of indications for interventions, benefits, limitations, risks and possible complications of procedures and therapies (Agha et al., 2005). Diagnostic thinking and decision-making skills can be acquired by clinical reasoning (CR) or clinical decision-making (CDM) courses (Young et al., 2020). CR/CDM is complex and challenging to teach (Baker et al., 2015) and to measure (Covin et al., 2020). While important for future practice, CR/CDM is not regularly implemented in curricula (Koenemann et al., 2020; Rothdiener et al., 2020). Previous research regarding CR or CDM explored case-based approaches with critical reflection of action (Homberg et al., 2019), serious games and virtual patients (Fleiszer et al., 2018), and paper or video-based discussion

groups (Weidenbusch et al., 2019), usually in small groups (Harendza et al., 2017; Koenemann et al., 2020), with a need for multiple tutors. Positive effects of course concepts might be attributed to collaborative learning (Weidenbusch et al., 2019). Teaching small groups has not been compared to lectures with large audiences or interactive online cases. A careful case selection, active student participation, immediate feedback and thoughtful involvement enhance the learning of CR/CDM (Kassirer, 2010). Team-Based-Learning courses (TBL) also facilitate the development of clinical decision-making skills (Michaelsen & Sweet, 2008). TBL further enhances teamwork skills through small group active learning in large classes (Burgess et al., 2018; Parmelee et al., 2012). TBL yielded positive results on surgical exam scores, with TBL being received favourably by participants (Burgess et al., 2014), albeit with potential for improvement (Kaminski et al., 2019).

Applying digital technologies for teaching and learning

Digitalisation in medical education should maximise the benefit from digital teaching and learning and prepare students to master digital technologies in patient care (Haag et al., 2018). One of the essential elements of TBL is the structured preparation. Guided questions can be used for preparation as learning tasks (Jakobsen & Knetemann, 2017). Preparatory material can be provided in a paper-based (offline) or online format. The advantages of an online format (ease of access, updates, structure, media availability) are apparent. Digital technologies are increasingly present in every aspect of medicine. Upon completion of their training, students will need to know how to use them for the patients' benefit. Digital tools can support educational techniques (Woods & Rosenberg, 2016).

We developed a surgical clinical decision-making course in a large group setting. Based on student ratings and perceptions, we analysed the TBL-structure concerning: use of online-learning/preparation with learning tasks – learning activities during the course – perceived differences to traditional formats – student satisfaction – change of interest in surgery – effects on their clinical decision-making strategies – experiences with the use of tablet computers as technical teaching aid. Questionnaires, semi-structured interviews and focus-group-interviews were used to answer these subjects.

2 Material and methods

Goals of the course

The novel course was developed for the 5th year of medical school to enhance student activity, team-based learning and provide clinical decision-making strategies in surgery.

Participants of the study

The students had no previous experience with clinical reasoning or decision-making courses. 142 students in the summer cohort 2018 and 124 students in the winter cohort 2018/2019 were trained. TBL was conducted in a large classroom setting with one tutor, in which the students were grouped into 5–6 students.

TBL structure

The TBL approach was used in the inverted classroom format with mandatory online preparation. Course material, literature and hyperlinks to the adaptive learning and reference platform Amboss® (AMBOSS GmbH, Berlin, Germany) were provided via the learning-management platform Moodle (Moodle Pty Ltd, West Perth, Australia). Learning tasks were provided to foster knowledge for pathologies, related to patient cases. Nine sessions covering various surgical cases leading to specific interventions were conducted. The cases were selected to cover frequent pathologies, adequately reflect the scope of surgical medicine and according to areas covered most frequently in Germany's centralised medical licensing exam. The "Team Readiness Assurance Test" often used in TBL (Parmelee et al., 2012) was modified to oral testing: Three pathology-related questions were presented and discussed in the beginning of the class, assessing and balancing the participants' level of knowledge. Sessions began in a large class with a case presentation. Diagnostic tests and examinations were performed in a virtual fashion by groups of 5–6 students. Results were presented on tablet computers. Eventually, the diagnosis made by the students led to a specific surgical intervention. Benefits and potential risks of the intervention were discussed together with the perioperative management. The students learned to gather sufficient information to make a sound decision in each case (Table 1).

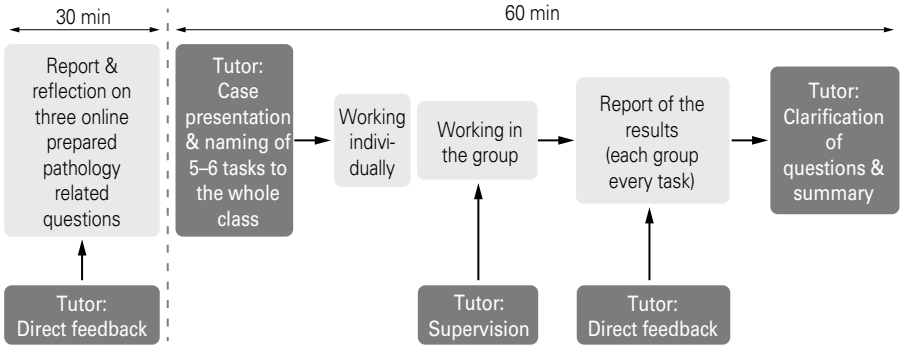
Table 1: Development of a patient case based on the learning objectives

Patient case – Development based on learning objectives:
– **History and physical examination is presented**
1. What do I have to initiate to find out the diagnosis?
– **Results of clinical testing (e.g. laboratory, imaging, etc.) is presented**
2. What differential diagnoses do I have to consider and how can I exclude them?
3. Why do I choose which therapy?
4. What do I have to take into consideration? (e.g. pre- and post-operative procedures)

Students were encouraged to evaluate, analyse and make decisions regarding five to six tasks in their group. The tasks covered specific learning objectives. Each group presented their conclusions to the class. A tutor acted as a facilitator, answering questions during the team time, providing test results, and feedback for clinical decisions and summarising the case at the end of the course (Figure 1). Tutors were taught how to provide feedback and were supported by written instructions. While each student

group developed different strategies, tutors' actions were as standardised as possible (digital supplement).

Figure 1: Course schedule in the novel "clinical decision-making in surgery" course



Digital technologies as teaching aids

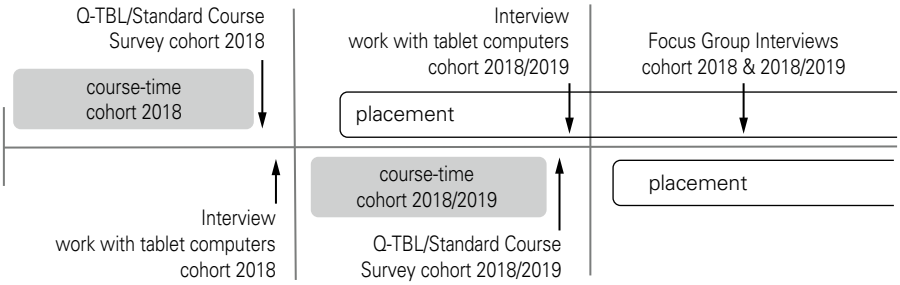
Results from imaging, diagnostic procedures and laboratory tests were presented on a tablet computer (iPad, Apple Inc., Cupertino, CA, USA). Imaging studies were provided using an app for DICOM (Digital Imaging and Communications in Medicine) data and telemedicine (Join – Medical Communication, Allm EMEA GmbH, Erlangen, Germany). Thus, results of diagnostic procedures were presented in a realistic fashion and students were introduced to the usability of these digital tools. Issues like data protection, ethics and potential benefits were discussed.

Data collection and analysis

We used a multi-method approach to evaluate the TBL-format, the problems and effects of the course and its multiple components (Timeline: Figure 2). After the course, students were given a questionnaire (Q-TBL) with 18 items derived from the "Knowledge Re-Consolidation Inventory" (Ahn et al., 2017) and adapted to our course. Questions covered the TBL structure like self-guided preparation, knowledge consolidation, retrieval practice, peer elaboration, feedback, and transfer of knowledge. Questions regarding attainment of surgical competencies, surgical interests and items on feasibility and acceptance of the course (including the use of digital tools) were added. The usability of these tools was explored in semi-structured interviews with ten randomly selected students of the two cohorts immediately after the course. Standardised questions included: "How was working with the tablet computers and the app?", "What was especially positive or negative about it?" and "What were the challenges?". The faculty of medicine conducts a mandatory survey for each course at the end of the semester. Results of the latter survey are included in this study; however, the questions were not specifically designed for this study and could not be modified. This led to different scales used for the answers.

A randomised sample of 18 students was selected for focus group discussions after completion of their exams and having started their placements. We assessed the impact of the course in preparing students for their exams and the applicability of the decision-making strategies in their routine clinical practice. The data was transcribed verbatim from recordings. The data analysis was conducted manually using a constant comparison approach. We used the deductive method for the interviews (Schulz et al., 2012). Each transcript was read by two independent persons. Topics were indexed, analysed, and a consensus was made to categorise content into different themes.

Figure 2: Timeline of the study



3 Results

Standard course survey of the faculty

75% (2018; n = 107) and 90% (2018/2019; n = 113) of the two cohorts participated in the standard course evaluation. Students were rather satisfied with the course and components (Table 2). Evaluation results are reported as mean ± standard deviation (*M* ± *SD*), Likert scale (1 = unsatisfied to 7 = absolutely satisfied).

Table 2: Results of the standard survey of the faculty: Standard Course Evaluation (N = 220, Likert scale 1 = absolutely unsatisfied, 7 = absolutely satisfied)

How satisfied are you with ...	*M* ± *SD*
… course content	5.6 ± 1.2
… organisation	5.6 ± 1.3
… preparation for exams	5.0 ± 1.7
… performance of the tutors	5.4 ± 1.2
… general conditions (rooms, technical support)	5.9 ± 1.1
… tools for preparation and postprocessing	5.6 ± 1.5
… subjective knowledge gain	5.3 ± 1.2
… course all in all	5.5 ± 1.3
… exam situation	4.9 ± 1.7

Questionnaire TBL (Q-TBL) – Components of the course

65% (2018; n = 93) and 90% (2018/2019; n = 113) of the respective cohorts answered the questionnaire regarding TBL components. The results are reported as *M* ± *SD*, Likert scale: 1 = strongly agree to 6 = strongly disagree. The results indicated that the students worked regularly with the *online material*, prepared for each course and found it relevant and helpful. TBL stimulated student activity, was useful, and tutors' feedback was helpful. Group work was rated average regarding recalling the content previously prepared online. Students appreciated the better memory of the content of the new course compared to traditional courses and of the content they applied themselves. The course was positive in teaching surgical content but did not change interest in surgical specialities. Satisfaction with the course concept was in the upper half of the scale (Table 3).

Table 3: Results of the Q-TBL – Components of the course (Likert scale 1 = totally agree; 6 = totally disagree)

Component		*M* ± *SD*
Online-Learning/ Preparation for the course (N = 206)	Regular preparation	2.2 + 1.3
	Material was relevant for the course	1.9 + 0.8
	Worked with learning aids	2.3 + 1.3
	Learning aids helped preparing the course	2.1 + 1.1
Learning Activities during the course (N = 209)	Regularly engaged myself in the course	2.2 + 1.1
	Was able to apply my knowledge	1.8 + 0.9
	Questions in the course were appropriate in relation to preparation	1.9 + 0.9
	High engagement of the group during discussions	2.3 + 1.0
	Group work helped to recall the content learned online	2.8 + 1.3
	Feedback of the tutors was helpful for understanding	2.2 + 0.9
Comparison of new course/experience of traditional seminars (N = 209)	Boredom during the course	4.6 + 1.0
	Good memory of the content of the course	2.6 + 0.9
	Better memory of the content of traditional lectures	3.9 + 1.2
	Better memory of the content that I applied in the course	2.3 + 1.0
Satisfaction with course/Surgical content (N = 206)	I think TBL is good	2.7 + 1.4
	I don't like group work	3.9 + 1.5
	Satisfied with course concept	2.1 + 0.8
	Think I learned surgical content	2.4 + 0.9
	Interest piqued	3.3 + 1.3
	More interest after course	3.4 + 1.6
	Interest before the course	3.1 + 1.7

Questionnaire and semi-structured interviews – "Work with tablet computers"

65% (2018; n = 93) and 87% (2018/2019; n = 109) of the cohorts rated the work with the tablet computer. Enthusiasm and didactic use received average marks (Table 4).

Table 4: Results of the Q-TBL – Supplementary questionnaire: "Work with tablet computers" (N = 206, Likert scale 1 = totally agree; 6 = totally disagree))

Item	*M ± SD*
It was fun to work with the digital tools	3.6 ± 1.3
Went flawlessly	3.1 ± 1.3
Was applied at sensible points	3.1 ± 1.2
Self-directed work with patient images was possible	3.2 ± 1.1
Realistic viewing was possible	2.5 ± 1.1

Positive and negative comments from the *semi-structured interviews* and suggestions were categorised. Students found the tools realistic, highlighted the self-directed working and would welcome the use in other courses. Technical issues and tutors not implementing the tools correctly counteracted efficiency (Table 5).

Table 5: Selection of answers of the semi-structured interviews – "Work with tablet computers"

Positive	Negative
– *"Very practice-orientated!"* – *"… good idea, I can Imagine working with it in other courses"* – *"… at last we can look at all the images of the CT-scan …"* – *"… to look at it and find the pathologies by ourselves was cool…"* – *"… should be used more often in other courses …"* – *"It activates a lot in the course … should be used more …"* – *"I would like to try it again!"*	– *"Not all of the tutors haven't used it in a meaningful way – some even didn't know what was on it … !"* – *"We didn't have enough time to work with the iPads."* – *"… the App didn't work always error free!"*

Focus group interviews

The focus group interviews explored how students experienced the self-directed online learning, the in-class (group) learning and if or how they adapted decision-making strategies during their placement. The interviews reflected, that *online preparation* motivated the students to work with the literature provided. Online learning tasks stimulated them to work not only with the provided material but motivated them to seek other links and literature. The acquired knowledge was sustained and helpful for the state exam. The success of working in groups depended on group dynamics and composition. The groups were helpful to accumulate knowledge. Refreshing previous knowledge was mentioned as well as the motivation to reassess the cases after the

course. The stimulated discussions in the course encouraged students to comment, discuss and clinically reflect in their placement. Students also highlighted an increase in confidence initiating discussions on diagnostic and therapeutic strategies with colleagues and residents. Reflecting on the appropriated *clinical decision-making in surgical management*, they now apply the structures learned to clinical practice, they especially mentioned evaluation of findings, result-related procedures, taking consent from patients. Students now apply the structure for processing differential diagnoses and therapy in their daily work. The course did not have substantial influence on career decision with most students having made their choices before the course, which was offered late in the curriculum. Students with few interests in surgery expressed new respect for surgical patient management.

4 Discussion and evaluation of the results based on recent literature

TBL has gained popularity in medical education, mainly in the US, Asia and Australia (Hong & Rajalingam, 2020) and surgery (Kaminski et al., 2019). It has been evaluated superior for the learning of specific skills compared to other methods (Cremerius et al., 2020; Parmelee et al., 2012). TBL should be highly organised with explicit instructions and useful resources (Kaminski et al., 2019). In Germany, we only know of one published TBL-format in the medical field, tested in continuing medical education of surgery (Kühne-Eversmann et al., 2008). We introduced TBL in a clinical decision-making course in the surgical field in a large class format. We used a multi-media approach with digital technology commonly used in patient care, to facilitate acquisition of digital competence. Students were introduced to telemedicine tools. The contents covered in our course were previously covered in various courses throughout medical school or not covered at all. Thus, a direct comparison to other formats taught previously or simultaneously was not possible. We believe that our course will become a regular feature of our curriculum. Based on the *standard course survey,* students were satisfied with the new course, its content, setup, and knowledge acquisition. Students' satisfaction is known to have influence on student motivation and their learning behaviour and thus on learning success (Peus et al., 2005). It is a valid measure for quality of teaching (Rindermann, 2001). The goals of our course concept concerning TBL have been achieved. Students worked with the prepared online material on a regular basis and found it helpful and relevant. They were able to retrieve and apply knowledge in class and learning retention was reported. In their self-assessment they rated their peer-work as very active and the tutor feedback supportive, the course in general was rated educational. A learning progress in the surgical field associated with TBL was established. Focus groups are appropriate to explore participants' views as well as the underlying perceptions and considerations (Rabiee, 2004). As interviews have been proven to analyse complex questions related to medical training (Stalmeijer et al., 2014), we used the focus groups to investigate and deepen the understanding

of the results of the questionnaire. Clinical decision-making is a complex competence, and it is difficult to measure this multidimensional construct (Covin et al., 2020). The results of our focus-group interviews show a good sample of how students perceived their self-directed learning using online learning tasks. This underlines that online preparation for TBL is crucial. The interviews also highlighted a known limitation of TBL: Group dynamics are important and can promote but also limit learning (Rajalingam et al., 2018). In the interviews we qualitatively explored students' perceptions reflecting on the TBL-course. Students applied the learned structure of clinical practice in their final year. It is remarkable that students credit the course with improved confidence in discussing clinical problems with residents and colleagues. We were able to teach surgical content and encourage learning retention. The course was able to develop clinical decision-making competencies in surgery. *Digital technologies* can support and facilitate self-directed learning activities (Curran et al., 2017; Han et al., 2019) and may be more effective than traditional learning due to improving knowledge and skills (Tudor Car et al., 2019). With digital technologies being further integrated into healthcare, medical curricula must prepare students for the healthcare environment they will work in (Haag et al., 2018). Embedding digital tools in undergraduate medical education is a challenge. It has been successfully implemented in optional electives in small groups, but not on a large scale in Germany (Kuhn et al., 2018). We demonstrated that the integration of digital tools can activate students in a large class format. These tools facilitate clinical decision-making. The data from structured interviews clarify the average rating in the questionnaire. If the tutor does not apply those skills in the correct way or does not allow enough time for learning, students become unsatisfied or even annoyed. Technical problems with the app or the image presentation were criticised and led to limitations in acceptance.

Study limitations

The results of this study are based only on student perceptions. Students voluntarily took part in the questionnaires, focus groups and semi-structured interviews, biasing our results. Their views may or may not be representative of the wider student or staff population, or applicable to other universities. No objective testing of factual knowledge was performed. Improvement in factual knowledge and analysing CR development was beyond the scope of this study and can be the focus of future research.

5 Conclusions

We successfully implemented the "clinical decision-making in surgery" course using a multi-media approach in a large class format. The complex course scenario included various didactic approaches as TBL using digital teaching aids and introducing digital tools. The investigation confirmed student satisfaction with the course and motivation with the pre-class learning process, sustained during class time. This led to a success-

ful learning of concepts in surgical patient management, which was sustainable and rated superior to traditional lectures. It influenced students' self-assurance in a positive way. Embedding future digital health technologies in an undergraduate clinical decision-making course enhances student activity but must be thoroughly introduced to teachers and students. Technical problems must be avoided. Career decisions were not influenced with the participants being very advanced in their training and decided regarding future careers.

References

Agha, R.A., Papanikitas, A., Baum, M., & Benjamin, I. (2005). The teaching of surgery in the undergraduate curriculum. Part II--Importance and recommendations for change. *Int J Surg, 3*(2), 151–157.

Ahn, H.S., Rotgans, J.I., Rajalingam P., Lee, J.J.R, Koh, Y.Y.J, & Low-Beer, N. (2017). Assessing How Students Learn in Team-Based Learning: Validation of the Knowledge Re-Consolidation Inventory. *Health Professions Education, 3*(2), 118–127.

Baker, R.C., Spence, R.A.J., Boohan, M., Dorman, A., Stevenson, M., & Kirk, S.J. (2015). A novel approach to improve undergraduate surgical teaching. *Ulster Med J, 84*(1), 30–36.

Burgess, A.W., McGregor, D.M., & Mellis, C.M. (2014). Applying established guidelines to team-based learning programs in medical schools: a systematic review. *Acad Med, 89*(4), 678–688.

Burgess, A., Roberts, C., Ayton, T., & Mellis, C. (2018). Implementation of modified team-based learning within a problem based learning medical curriculum: a focus group study. *BMC Medical Education, 18(1)*, 74.

Covin, Y., Longo, P., Wick, N., Gavinski, K., & Wagner, J. (2020). Empirical comparison of three assessment instruments of clinical reasoning capability in 230 medical students. *BMC Medical Education, 20*(1), 264–267.

Cremerius, C., Gradl-Dietsch, G., Beeres, F.J.P., Link, B.-C., Hitpaß, L., Nebelung, L., Horst, K., Weber, C.D., Neuerburg, C., Eschbach, D., Bliemel, C., & Knobe, M. (2020). Team-based learning for teaching musculoskeletal ultrasound skills: a prospective randomised trial. *European Journal of Trauma and Emergency Surgery, 34*(5), e275-11.

Curran, V., Matthews, L., Fleet, L., Simmons, K., Gustafson, D.L., & Wetsch, L. (2017). A Review of Digital, Social, and Mobile Technologies in Health Professional Education. *Journal of Continuing Education in the Health Professions, 37*(3), 195–206.

Fleiszer, D., Hoover, M.L., Posel, N., Razek, T., & Bergman, S. (2018). Development and Validation of a Tool to Evaluate the Evolution of Clinical Reasoning in Trauma Using Virtual Patients. *J Surg Educ, 75*(3), 779–786.

Haag, M., Igel, C., Fischer, M., German Medical Education Society (GMA), Committee "Digitization – Technology-Assisted Learning and Teaching", Joint working group

"Technology-enhanced Teaching and Learning in Medicine (TeLL)" of the German Association for Medical Informatics, Biometry and Epidemiology (gmds), & the German Informatics Society (GI). (2018). Digital Teaching and Digital Medicine: A national initiative is needed. *GMS Journal for Medical Education, 35*(3), Doc43.

Han, E.-R., Yeo, S., Kim, M.-J., Lee, Y.-H., Park, K.H., & Roh, H. (2019). Medical education trends for future physicians in the era of advanced technology and artificial intelligence: an integrative review. *BMC Medical Education, 19*(1), 460–475.

Harendza, S., Krenz, I., Klinge, A., Wendt, U., & Janneck, M. (2017). Implementation of a Clinical Reasoning Course in the Internal Medicine trimester of the final year of undergraduate medical training and its effect on students' case presentation and differential diagnostic skills. *GMS J Med Educ, 34*(5), Doc66.

Homberg, A., Oberhauser, H., & Kaap-Fröhlich, S. (2019). Clinical reasoning – an approach for decision-making in education and training for biomedical scientists. *GMS J Med Educ, 36*(6), Doc81.

Hong, J.M., & Rajalingam, P. (2020). Geographic Trends in Team-based Learning (TBL). Research and Implementation in Medical Schools. *Health Professions Educations, 6*(1), 47–60.

Jakobsen, K.V., & Knetemann, M. (2017). Putting Structure to Flipped Classrooms Using Team-Based Learning. *International Journal of Teaching and Learning in Higher Education, 29*(1), 177–185.

Kaminski, A.D., Babbitt, K.M., McCarthy, M.C., Markert, R.J., Roelle, M.P., & Parikh, P.P. (2019). Team-Based Learning in the Surgery Clerkship: Impact on Student Examination Scores, Evaluations, and Perceptions. *J Surg Educ, 76*(2), 408–413.

Kassirer, J.P. (2010). Teaching Clinical Reasoning: Case-Based and Coached. *Academic Medicine, 85*(7), 1118–1124.

Koenemann, N., Lenzer, B., Zottmann, J.M., Fischer, M.R., & Weidenbusch, M. (2020). Clinical Case Discussions – a novel, supervised peer-teaching format to promote clinical reasoning in medical students. *GMS J Med Educ, 37*(5), Doc48.

Kühne-Eversmann, L., Eversmann, T., & Fischer, M.R. (2008). Team- and Case-Based Learning to Activate Participants and Enhance Knowledge: An Evaluation of Seminars in Germany. *Journal of Continuing Education in the Health Professions, 28*(3), 165–171.

Kuhn, S., Kadioglu, D., Deutsch, K., & Michl., S. (2018). Data Literacy in medicine. What comptences does a physician need? *Der Onkologe, 24*(6), 368–377.

Michaelsen, L., & Sweet, M. (2008). The essential elements of team-based learning. *New Directions for Teaching and Learning, 2008*(116), 7–27.

Parmelee, D., Michaelsen, L., Cook, S., & Hudes, P.D. (2012). Team-based learning: A practical guide. AMEE Guide No. 65. *Med Teach, 34*(5), e275–87.

Peus, V., Valerius, G., Schärer, L., Freyer, T., Berger, M., & Voderholzer, M. (2005) Teaching Evaluation at the Medical Faculty of Freiburg, part II: formative teaching evaluation. *GMS J Med Educ, 22*(2), Doc 17.

Rabiee, F. (2004). Focus-group interview and data analysis. *Proc Nutr So, 63*(4), 655–660.

Rajalingam, P., Rotgans, J.I., Zary, N., Ferenczi, M.A., Gagnon, P., & Low-Beer, N. (2018). Implementation of team-based learning on a large scale: Three factors to keep in mind. *Med Teach, 40*(6), 582–588.

Rindermann, H. (2001). Die studentische Beurteilung von Lehrveranstaltungen -Forschungsstand und Implikationen. In C. Spiel (Ed.), *Evaluation universitärer Lehre zwischen Qualitätsmanagement und Selbstzweck* (pp. 61–88). Münster: Waxmann.

Rothdiener, M., Griewatz, J., Meder, A., Dall'Acqua, A., Obertacke, U., Kirschniak, A.,Borucki, K., Koenig, S., Ruesseler, M. Steffens, S., Steinweg, B., & Lammerding-Koeppel, M. (2020). Surgeons' participation in the development of collaboration and management competencies in undergraduate medical education. *SICOT, 15*, e0233400.

Ruesseler, M., Schill, A., Stibane, T., Damanakis, A., Schleicher, I., & Menzler, S. (2013). "Practical clinical competence" – a joint programme to improve training in surgery. *Zentralbl Chir., 138*(6), 663–668.

Schulz, M., Mack, B., & Renn, O. (Eds.). (2012). *Fokusgruppen in der empirischen Sozialwissenschaft.* Springer-Verlag. https://doi.org/10.1007/978-3-531-19397-7

Stalmeijer, R., McNaughton, N., & van Mook, W. (2014). Using focus groups in medical education research. AMEE Guide No. 91. *Med. Teach., 36*(11), 923–939.

Tudor Car, L., Kyaw, B.M., Dunleavy, G., Smart, N.A., Semwal, M., Rotgans, J.I., Low-Beer, L., & Campbell, J. (2019). Digital Problem-Based Learning in Health Professions: Systematic Review and Meta-Analysis by the Digital Health Education Collaboration. *Journal of Medical Internet Research, 21*(2), e12945.

Weidenbusch, M., Lenzer, B., Sailer, M., Strobel, C., Kunisch, R., Kiesewetter, J., Fischer, M.R., & Zottmann, J.M. (2019). Can clinical case discussions foster clinical reasoning skills in undergraduate medical education? A randomised controlled trial. *BMJ Open, 9*(9), e025973.

Woods, M., & Rosenberg, M.E. (2016). Educational Tools: Thinking Outside the Box. *CJASN, 11*(3), 518–526.

Young, M.E., Thomas, A., Lubarsky, S., Gordon, D., Gruppen, L.D., & Rencic, J. (2020). Mapping clinical reasoning literature across the health professions: a scoping review. *BMC Medical Education, 20*(1), 107–111.

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A framework for students' competence development in undergraduate medical education

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In the medical profession, a main focus is on the situation-specific integration of different competencies for optimal patient care. Thus, undergraduate and postgraduate medical education must integrate a competency-based approach to enhance students' growth towards authentic and complex healthcare practice. Frameworks to guide the development of medical curricula centred on consecutive, situation-specific competence development barely exist so far. Thus, in this paper, we propose a theoretical framework for competence development in undergraduate medical education. We combined Blömeke et al.'s (2015) model known as *competence as a continuum* and Grossman et al.'s (2009) frame called *approximations of practice*. Our framework can be understood as a structural concept for medical curriculum designers and teachers to deliberately approximate students' cognitive and affective resources, situation-specific skills and performance.

1 Introduction

In the medical profession, a main focus is on the situation-specific integration of different competencies for optimal patient care (ten Cate, Snell, & Carraccio, 2010). Consequently, worldwide, undergraduate and postgraduate medical education is increasingly aligned with a competency-based approach. Consensus exists that competence in performing tasks of high complexity goes beyond knowledge or simple skills (ten Cate et al., 2010). *Competency* (plural *competencies*) refers to the different constituents (cognitive and affective dispositions, skills) of competence; *competence* (plural *competences*) describes the integration of all the necessary constituents in a performance situation and is, therefore, the "*broader term and a complex characteristic*" (Blömeke, Gustafsson, & Shavelson, 2015, p. 5). In this paper, we will predominantly refer to *competence* as we focus on medical students learning to successfully integrate these constituents in performance situations as required for their later professional practice (ten Cate et al., 2010). Frameworks for facilitating the development of consecutive, situation-specific competence in medical curricula barely exist so far. In the German context, a new Licensure Act for Medicine expected in 2025 will make the implementation of such competence-based curricula compulsory.

The concept of Entrustable Professional Activities (EPAs) focuses on the performance of defined and interrelated complex units of practice within the clinical environment (ten Cate & Scheele, 2007). Each EPA is based on different competencies (Berberat, Harendza, & Kadmon, 2013; ten Cate & Scheele, 2007). Initially, EPAs were introduced for postgraduate medical education, but the concept is receiving increasing attention in undergraduate medical education (Berberat et al., 2019; Chen, van den Broek, & ten Cate, 2015), too. In Germany, a recent revision of the National Catalogue of Competence-Based Learning Objectives for Medical Education [NKLM] (MFT Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V., 2015) defines the graduation profile for medical students by means of such EPAs (e.g. "performing discharge management of a patient or ambulatory care of a chronically ill patient"). Further deconstructed EPAs, called "nested EPAs", break down these daily clinical routines into manageable, less complex components which are suitable for students in earlier semesters (e.g. "performing an anamnesis and physical examination appropriate to the situation and summarising the results in a structured manner"). In this sense, nested EPAs are used as learning activities that provide opportunities for students to apply their knowledge and skills to clinical demands early in the study programme. These nested EPAS are subsumed in the "full" EPAs during the final practical year.

In this paper, we propose a theoretical framework for competence development towards the EPA level in undergraduate medical education. The framework seeks 1) to identify the relevant determinants for competence development and 2) to suggest approximation steps to foster the development process towards authentic medical practice. In addition, the framework assists researchers in investigating competence development more precisely. In developing the framework, we focused on a well-established model by Blömeke et al. (2015) known as *competence as a continuum*. Secondly, we invoked an interdisciplinary teaching and learning framework for approximating authentic practice developed by Grossman et al. (2009), called *authenticity in approximations of practice*. The resulting framework addresses a relevant gap in the competence literature by combining a competence modelling perspective with a student development perspective (Blömeke et al., 2015).

2 Current competence modelling

As stated in the introduction, Blömeke et al. (2015) define competence as a complex interplay of a person's cognitive and affective resources and skills as applied in real-world performance. To model competence, the typical real-world performance demands of a field (criterion situations) serve as points of reference, for example, a pilot flying an airplane, a heart surgeon performing a heart surgery, or a seven-year-old primary school pupil reading a book. Blömeke et al. (2015) explain the two dominant perspectives on competence as follows:

2.1 The holistic and the analytic perspective

The holistic perspective is centred on performance or behaviour in a real-world situation. In a performance situation, a person needs to integrate their cognitive and affective resources and skills dynamically during the course of a performance situation. To assess competence from a holistic perspective, one would observe a medical student carrying out concrete activities in a real-world (criterion) situation (Blömeke et al., 2015, p. 6). Such situations should be carefully chosen to represent the demands, complexity and variety of tasks in the real world. The holistic perspective, therefore, focuses on how someone performs and behaves in a dynamic real-world situation.

The analytic perspective focuses on deconstructing the complex and dynamic interplay of cognitive (factual, procedural, strategic and attitudinal knowledge), affective (emotion), motivational (motivation) and conative (effort) components. These are collectively referred to as a person's *dispositions* or *resources*. These resources are dynamic and amenable to educational influence. Analytic deconstruction of a person's resources can help to reduce complexity and identify knowledge and motivational components that can be taught deliberately and assessed in suitable learning environments. Thus, the analytic perspective disentangles the resources latently guiding real-world performance.

2.2 Competence as a continuum

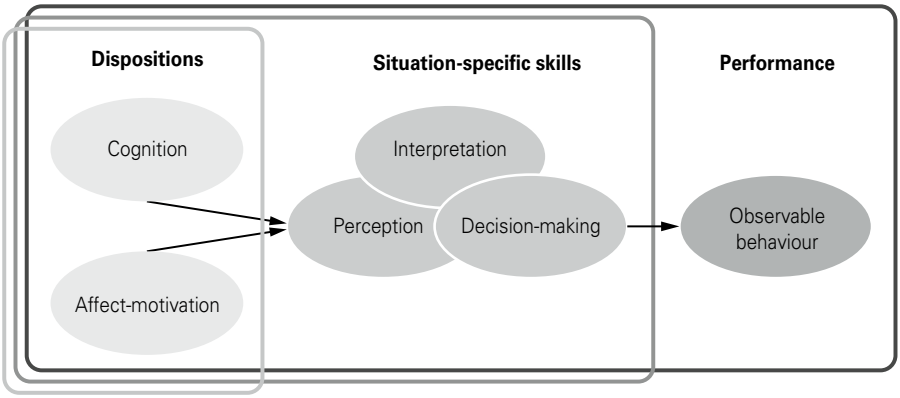
Blömeke et al.'s (2015) account of competence integrates the holistic and analytic perspectives. In their model (Figure 1), the authors identify situation-specific skills as the connections between resources (referred to as *dispositions*) and performance. The combination of a person's cognitive and affective resources is manifested in situation-specific skills that lead to observable behaviour in a performance situation. Situation-specific skills situate the processes of perception, interpretation and decision-making (Blömeke et al., 2015, p. 7).

Perceptions and interpretation. From a cognitive science perspective (Rumelhart, 1980), the way we perceive information about the world is determined by our concept of the world. In teacher training, for example, this process is regarded as professional vision, which considers teachers' selective attention to classroom events (= noticing), followed by a knowledge-based interpretation of those events (= reasoning) (Seidel & Stürmer, 2014).

Decision-making. After perceiving and interpreting a situation, decision-making represents the transitional step towards observable behaviour. A decision can be influenced by a subjective cost-benefit analysis (Schoenfeld, 2015) of the alternatives (Kahneman,

2013) and by additional factors such as situation-specific knowledge, experience with similar situations, intuition, attitudes and motivational/emotional states. If the situation is familiar, the decision can invoke familiar routines; otherwise, it involves reconsideration (Schoenfeld, 2015, p. 234).

Figure 1: Competence as a continuum (recreated from Blömeke et al., 2015)



"Collating" real-world scenarios and their relevant resources and skills. As *"competence ultimately refers to real-world performance"* (Blömeke et al., 2015; p. 6), one needs to identify real-world situations, describe their features (e.g. features of the patient, the surroundings, the necessary tools, the relevance of time, team aspects, communication and unexpected changes during the situation) and the performance demands for mastering these features. More complex situations require higher competence. As explained earlier, EPAs can be understood as a collection of real-world situations as they "*are core units of professional practice*" (ten Cate et al., 2018, p. 506). To foster the development of competence toward the EPA-level, students need to be provided with smaller (nested) practice activities in the course of their study (ten Cate et al., 2018). Therefore, the resources and situation-specific skills underlying competent performance need to be defined analytically.

Example: Taking a blood sample. We illustrate competence as a continuum in the criterion situation of taking a blood sample together with its features and performance demands. While taking a blood sample is often regarded as a basic procedural skill, we argue that it needs to be considered as an operationalised competence of the nested-EPA "carry out medical procedures in a patient-safe manner". Safe and competent blood sampling requires cognitive resources: factual knowledge, (e.g. knowing the vein anatomy as well as indications and contraindications) as well as procedural knowledge (e.g. knowing how to handle the needle and having knowledge of correct disinfection procedures), strategic knowledge (knowing how to react to a patient who

is uncomfortable during blood sampling and threatens to lose consciousness due to circulatory problems) and attitudinal knowledge (e.g. "I am good at drawing blood") (Mayer, 2010). Affective resources involve worries about harming the patient, fear of drawing blood and a reduced self-concept of ability after mispuncturing. Variations in patients' vein discernibility, patients' different reactions to pain and variations in the amount of trust they place in the physician, and knowledge about indications for blood sampling require situation-specific skills such as perceiving vein discernibility in the left and right arm's vein, interpreting which arm is more promising and deciding which arm to choose. The latent interplay of these resources and situation-specific skills is followed by observable behaviour (the actual procedure of drawing blood while communicating with the patient). The whole process unfolds differently for a medical student without experience and for one with a background in nursing, or in a situation with a higher stress level, for example, if the patient blacks out.

Summary. For a competent real-world performance, a person must successfully draw on an interplay of cognitive and affective resources and then translate them into situation-specific skills (through perception, interpretation and decision-making). These latent processes manifest in an observable performance. Despite capturing the interplay described and moving beyond both the holistic (the performance) and the analytic (the resources) viewpoints, the model does not yet address how individuals are to be supported in their development of the resources and situation-specific skills required.

3 Approximation steps to support students' competence development

3.1 The developmental perspective on competence

A developmental perspective on competence introduces additional complexity (Blömeke et al., 2015). In the sequential conception of higher education programmes, certain resources have to be established before situation-specific skills can be developed, giving someone the accountability to perform. This is evident in curricula that place theoretical courses first and practical experience second. Knowledge is certainly a pre-requisite for competent performance. However, such a curricular structure neglects the fact that growth in competence in all dimensions can take place simultaneously (Blömeke et al., 2015). The artificial separation of resources and situation-specific skills/performance can lead to the often discussed gap between theory and practice (Grossman et al., 2009) or to the development of inert knowledge (Renkl et al., 1996). Deliberate approximation of real-world scenarios can support the explicit growth of the various determinants of competence (resources, situation-specific skills and performance).

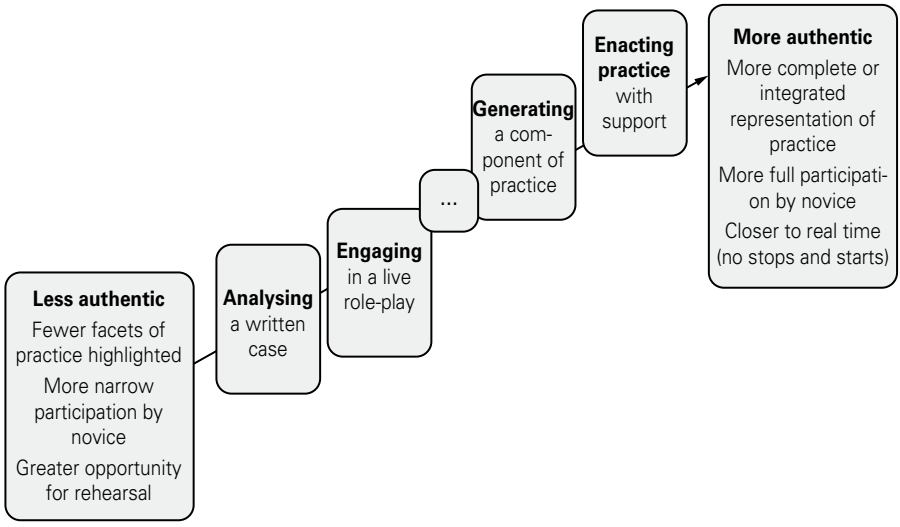
3.2 Approximations of practice

Grossman et al. (2009) suggest a stepwise approximation model (Figure 2). They define practice in complex domains, such as in teaching or medicine, as an orchestra "*of understanding, skill, relationship, and identity to accomplish particular activities with others in specific environments*" (Grossman et al., 2009, p. 2059). They emphasise the following:

1) Relationship and identity: The term *relationship* describes the growth and maintenance of productive professional interactions such as those between doctor and patient. *Identity* captures personality and individual ethics.
2) Particular activities and specific environments: Each discipline has specific characteristics that determine its ethos. For example, a general practitioner is confronted with different types of decision-making than a physician in an emergency room. In approximating practice, medical education needs to take these specifics into account even at the undergraduate level.

The "approximations of practice" model shown in Figure 2 is stratified along an authenticity axis. Less authentic settings reflect fewer facets of real practice, more scaffolding and more options for rehearsal. More authentic settings are closer to real practice in real time.

Figure 2: Approximations of practice (adapted from Grossman et al., 2009)



Deconstruction. The steps (analysing, engaging, generating and enacting) taken to deconstruct the authenticity spectrum (Grossman et al., 2009) can be understood as a deliberate guide toward authentic practice. Examples might include *analysing* through discussion of a paper or video case, *engaging* in a role-play of physician-patient communication or conducting a physical examination of a fellow student, *generating* documentation for a patient case and *enacting* a patient examination at the bedside.

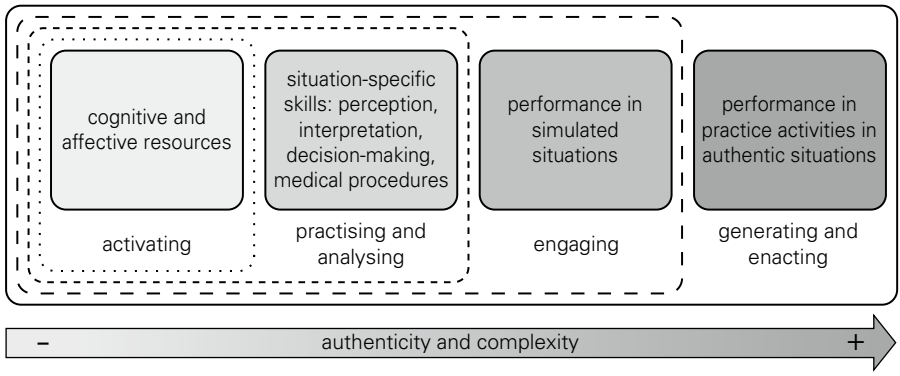
Representations of practice. Representations of practice support the learner in observing and understanding practice and can be understood as teaching mediums for the mentioned deconstruction steps. They include written case vignettes, video depictions of professional situations, equipment and tools used in practice and real-life observations in clinical settings. They vary in their representation of the realistic aspects of practice. For example, a video may illustrate the interactivity and liveliness of a situation (e.g. a knee joint puncture) while failing to reveal the underlying reasons for the observed behaviour (e.g. the physician's decision to use a certain technique or the application of certain equipment).

4 A framework for students' competence development in undergraduate medical education

4.1 Premise of the framework

When performing in a specific situation, a competent physician has to apply resources and situation-specific skills correctly. Thus, a competence-based curriculum needs to provide learning environments that deliberately address aspects of the competence continuum and achieve adequate deconstruction without risking the *"acquisition of disembodied skills"* (Grossman et al., 2009, p. 2070). Therefore, a competence development framework needs to consider both the determinants of competence and their deliberate approximation. Following this premise, we integrated Blömeke et al.'s (2015) competence model with Grossman et al.'s (2009) approximation steps. The resulting competence development framework for medical education is illustrated in Figure 3.

Figure 3: A framework for students' competence development in undergraduate medical education



4.2 Conceptualisation of the framework

4.2.1 Authenticity and complexity axis

The framework is structured by an authenticity and complexity axis from left to right. The right represents the graduate level of medical education and, therefore, includes authentic practice under supervision. On this level, the student should be able to integrate his or her resources and situation-specific skills to perform competently in the authentic situations defined by the EPAs.

4.2.2 Identifying determinants of competence development

For the next conceptualisation step, the question was: What do we need to consider from a competence development perspective in medicine? The reconsolidation of Blömeke et al.'s (2015) determinants led to the following:

Cognitive and affective resources were kept as the relevant pre-condition for any competent performance. *Medical procedures* (e.g. saturation, needle handling, disinfection, handling a transducer etc.) were added to the situation-specific skills to explicate their inevitable need in the medical context. Further, we disentangled performance. From the developmental perspective, this led to *performance in simulated situations* and *performance in practice activities in authentic situations*. Simulated situations imitate real world situations but take place in the context of a scripted scenario (e.g. in a training centre) with previously defined learning objectives that are reduced in complexity to increase safe-space learning (e.g. physical examination on an actor or peer).

4.2.3 Approximation steps to foster competence development

After identifying the determinants for medical competence development, the question was: How can we visualise suitable approximation steps while making the following assumptions? 1) Competence growth might occur simultaneously in terms of resources, situation-specific skills and performance (Blömeke et al., 2015), 2) learners' competence development might be uneven during their study programme, depending on their growing level of expertise and specialised medical interests and 3) learning environments need to provide options for re-consolidation and rehearsal of individual resources, situation-specific skills and performance.

Therefore, the approximation steps were visualised by nested boxes with perforated lines. A demonstration of the framework is provided below using the example of sonography of the kidneys (nested EPA "Situation-specific anamneses, patient examination and documentation of results").

Activating. Learning environments such as lectures focusing on the teaching of predominantly factual knowledge (e.g. anatomy and physiology of the kidneys) need to provide activating learning elements to avoid inert knowledge. Low-threshold, visual representations of procedures and strategies applied in medical practice (e.g. pictures of a healthcare professional handling a transducer for kidney sonography) can be a didactical feature. The fine-granulated line around "activating" indicates that at any higher approximation level, the learners should be able to access their cognitive and affective resources.

Practising and analysing. Following the logic of the authenticity and complexity axis, medical students should be provided with learning environments that support practising and analysing situation-specific skills (e.g. first, observing video material of kidney sonography with patients of varying ages and varying treatment decisions and then trying the technical functions of sonography). Suggested by the perforated lines, these learning settings should allow for both the reconsolidation of resources and the availability of gained skills in consecutive performance situations.

Engaging. In these activities, students apply their resources and situation-specific skills in scripted scenarios, simulations and safe-space learning settings with an actor, peer or virtual patient. Depending on students' level of expertise, such settings can be deliberately varied in terms of demands and time pressure; for example, a first-year student carries out a sonography with a peer who expresses no pain and communicates as a fellow peer, while a student in second year is confronted with an actor imitating pain or restricted communication abilities.

Generating and enacting. These take place in the highest approximating step subsumed in the competence level of an EPA. The learner enacts in a supervised authentic performance situation (e.g. conducts a kidney sonography with a real patient) and/or generates practice pieces (e.g. documents the results of a sonography). Variation of complexity and authenticity is achieved by a deliberate choice of challenging patient cases (e.g. sonography with an uncooperative patient with pain) or time pressure (e.g. in an emergency setting).

The perforated lines indicate variable learning trajectories towards this approximation level. A first-year student might benefit from sequentially experiencing all the approximation steps, whereas an advanced student may skip the approximation steps for certain competencies. The perforated lines also indicate opportunities for rehearsal or review of previous approximation steps when difficulties arise in a performance situation (e.g. re-watching video material about sonography after difficulties with an authentic patient situation).

5 Conclusion

Curricular designers can apply the suggested framework to develop and schedule relevant approximation steps for competence development characterised by an intensification of authenticity and complexity in accordance with learners' medical expertise or discipline-specific emphasis, for example, in a spiral curriculum (Davis & Harden, 2003). The transparent communication of the heuristic of the framework both for students and teachers could additionally foster students' reflection on their competence development as well as shape teachers' feedback; for example, a teacher might advise a student to go back to the simulated performance level after the student experiences difficulties in an authentic performance situation. A competence-based curriculum should provide opportunities for such feedback and self-reflection in an "approximation [of] practice jumping".

Medical teachers can consider the approximation steps as the didactical implications of deliberate deconstruction and representation on the authenticity and complexity spectrum. The following questions (inspired by Grossman et al., 2009) can support a deliberate choice of approximation levels and their representation:

- What determinants of competence should be addressed in a teaching unit or semester or work placement, and which representations trigger them best?
- Have students had sufficient prior experience and developmental opportunities to be able to engage in the intended learning activity?
- What facets of authentic and complex practice are visible to the learner by the representation, which remain (purposefully) hidden?

- To what extent does a certain representation enforce students' involvement in practice?

From a research perspective, we encourage empirical testing of the suggested framework. Research questions could investigate whether the competence determinants are best learned one step after another or via short-cuts and rehearsal of certain approximation steps. Additionally, a differential understanding of learning trajectories by diverse learners is needed. Consequently, the framework could benefit from a revision based on these empirical findings.

The framework is currently a conceptual contribution that has not yet been implemented in a medical curriculum. The challenges of transferring concepts to practice are known (Nousiainen et al., 2017), and this is a limitation of our contribution. Medical education programmes with opportunities to redesign and revise the curriculum will play a pivotal role in demonstrating the implementation of our conceptual frame.

References

Berberat, P.O., Harendza, S., & Kadmon, M. (2013). Entrustable professional activities – visualization of competencies in postgraduate training. Position paper of the Committee on Postgraduate Medical Training of the German Society for Medical Education (GMA). *GMS Journal for Medical Education, 30*(4), Doc47. doi:10.3205/zma000890

Berberat, P.O., Rotthoff, T., Baerwald, C., Ehrhardt, M., Huenges, B., Johannink, J., Narciss, E, Obertacke, U., Peters, H., & Kadmon, M. (2019). Entrustable Professional Activities in final year undergraduate medical training – advancement of the final year training logbook in Germany. *GMS Journal for Medical Education, 36*(6), Doc70. doi:10.3205/zma001278

Blömeke, S., Gustafsson, J.-E., & Shavelson, R.J. (2015). Beyond dichotomies – Competence Viewed as a Continuum. *Zeitschrift für Psychologie, 223*(1), 3–13. doi:10.1027/2151-2604/a000194

ten Cate, O., & Scheele, F. (2007). Competency-based postgraduate training: Can we bridge the gap between theory and clinical practice? *Academic Medicine, 82*(6), 542–547. doi:10.1097/ACM.0b013e31805559c7

ten Cate, O., Snell, L., & Carraccio, C. (2010). Medical competence: The interplay between individual ability and the health care environment. *Medical Teacher, 32*(8), 669–675. doi:10.3109/0142159x.2010.500897

ten Cate, O., Graafmans, L., Posthumus, I., Welink, L., & van Dijk, M. (2018). The EPA-based Utrecht undergraduate clinical curriculum: Development and implementation. *Medical Teacher, 40*(5), 506–513. doi:10.1080/0142159X.2018.1435856

Chen, H. C., van den Broek, W. E., & ten Cate, O. (2015). The case for use of entrustable professional activities in undergraduate medical education. *Academic Medicine, 90*(4), 431–436. doi:10.1097/acm.0000000000000586

Davis, M. H., & Harden, R. M. (2003). Planning and implementing an undergraduate medical curriculum: The lessons learned. *Medical Teacher, 25*(6), 596–608. doi:10.1080/0142159032000144383

Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. W. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record, 111*(9), 2055–2100.

Kahneman, D. (2013). *Thinking, fast and slow*. Penguin Books.

Mayer, R. E. (2010). Applying the science of learning to medical education. *Med Educ, 44*(6), 543–549. doi:10.1111/j.1365-2923.2010.03624.x

MFT Medizinischer Fakultätentag der Bundesrepublik Deutschland e.V. (2021). *Nationaler Kompetenzbasierter Lernzielkatalog 2.0 (NKLM 2.0).* Retrieved 07.10.2021 from https://nklm.de/

Nousiainen, M. T., Caverzagie, K. J., Ferguson, P. C., & Frank, J. R. (2017). Implementing competency-based medical education: What changes in curricular structure and processes are needed? *Medical Teacher, 39*(6), 594–598. doi:10.1080/0142159X.2017.1315077

Renkl, A., Mandl, H., & Gruber, H. (1996). Inert knowledge: Analyses and remedies. *Educational Psychologist, 31*(2), 115–121. doi:10.1207/s15326985ep3102_3

Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension* (pp. 33–49). Hillsdale: Lawrence Erlbaum Associates.

Schoenfeld, A. H. (2015). How we think: A theory of human decision-making, with a focus on teaching. In Sung Je Cho (Ed.), *The proceedings of the 12th International congress on mathematical education* (pp. 229–243). Cham: Springer.

Seidel, T., & Stürmer, K. (2014). Modeling and measuring the structure of professional vision in preservice teachers. *American Educational Research Journal, 51*(4), 739–771. doi:10.3102/0002831214531321

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Impact of mandatory placements in the final year on choosing a subject for postgraduate training?

Elisabeth Narciß, Katrin Schüttpelz-Brauns, Udo Obertacke

With a predicted shortage of junior doctors, especially in general medicine and surgery, we were interested to find out (a) what factors affect medical students or graduates when choosing their specialty and if a medical school has the means to influence this choice, (b) how the elective specialty for postgraduate training develops over the course of medical studies, (c) when medical students decide on the subject for their postgraduate training, (d) which specialties are mostly chosen and (e) if clerkships and the mandatory stages in the final year have an impact on the specialty choice.
An extensive literature research of German and international literature shows that mentoring and positive role models are very important factors in choosing the specialty. Our own evaluation data from final-year students demonstrate that practical placements like clerkships and mandatory subjects in the final year play a decisive role in taking a mandatory subject into consideration for specialty training.

1 The junior staff scenario – are there enough places for medical studies in Germany?

Shortly after the turn of the millennium (2003/2004), *Germany's federal Association of Statutory Health Insurance Physicians* (*SHI physicians, Kassenärztliche Bundesvereinigung, KBV*), followed by the professional associations initiated the discussion about a looming shortage of junior doctors after experiencing an excess of medical graduates in the 1980s and 1990s – the so-called *abundance of physicians*. This discussion coincided with a fundamental change in the *German Medical Licensing Regulations for Physicians* (*Approbationsordnung für* Ärzte*,* ÄAppO) of 2002. By establishing more small-group instruction in the medical curriculum, including bedside teaching and block courses while maintaining the same level of faculty in the medical schools, the number of places for medical students decreased. An all-time low was reached with a total of 78,545 students in 2007/2008. Since then, the number of medical students has increased by about 20% to 98,736 in 2019 (Statistisches Bundesamt, 2020). However, the specifications of the *Master Plan for Medical Studies 2020* (BMBF, 2020), again emphasising more practical training and promoting general practice, could again lead to a reduction in the number of study places – even if politically unwanted.

According to the *Medical Report 2012* (*Medizinerreport 2012*, Schwarzer & Fabian, 2012), the drop-out rate for medical students in 2010 had decreased to 5% (*Association of Medical Schools,* Medizinischer Fakultätentag, MFT, 2010) and now ranges between 5% and 11%, which is significantly lower than for all other study programmes.

In 2006, when the first cohort of students completed their medical studies according to the new ÄAppO of 2002, the number of graduates was 8,724. Since then, this number increased to about 10,000 graduates each year (Institut für medizinische und pharmazeutische Prüfungsfragen, IMPP, 2020). This shows that the decline in the number of graduates was stopped, though it did not reach the level of graduates in the 1990s – e.g. 11,978 graduates in 1994 (Kopetsch, 2010).

Meanwhile, the question of whether the medical graduates had really started working as physicians was raised, too. The *Bavarian Graduate Panel* (*Bayerisches Absolventenpanel*, Falk et al., 2016), including data from 479 medical graduates about one and a half years after completing their studies, showed that 98.2% had taken up or were planning to take up specialty training. Less than 1% stated that they were not working in the medical field (Falk et al., 2016; Gartmeier et al., 2017). Schwarzer and Fabian (2012) also show that 94–98% of medical graduates work in patient care.

1.1 How serious is the current shortage of young medical professionals?

Forecasts in 2010 (Kopetsch, 2010; KBV, 2012) postulated that the shortage of junior doctors in outpatient medicine in 2020 would be so severe that many positions for SHI physicians would not be filled.

However, it is difficult to verify whether these forecasts have come true and to calculate precisely how many junior doctors are actually lacking in which specialty – and how many are needed in the future (Heinz & Jacob, 2012; Stengler et al., 2012).

The shortage of general practitioners predicted especially for rural regions had already broadened to the specialist practice area in 2010, e.g. ophthalmology and ear, nose and throat medicine (KBV, 2012).

At the same time surgical specialties started to discuss the difficulties in attracting junior doctors – especially for general surgery and trauma surgery (Mittlmeier et al., 2010; Osenberg et al., 2010).

Thus it remains unclear whether there is a general shortage of junior doctors or more of a distribution problem across the specialties.

1.2 Labour market for junior doctors

The demand for junior doctors, which has now reached hospitals, too, makes graduates a valuable resource. Indeed, the current job market is characterised by strong competition for recruiting medical graduates (Hibbeler, 2012). For the first time, the new generation of junior doctors has a better chance of having the expectations of their future jobs fulfilled (Kopf, 2014).

Now junior doctors can usually choose a specialty and location for their postgraduate training and often are spoilt for choice. Freshly licensed junior doctors visit their favoured hospitals for a one-day work shadowing and extended interviews and discussions with the head of department and registrars (Kopf, 2014). The question of "work-life-balance", – raised by more than 90% of medical students – is becoming increasingly more important. In addition, 92.6% of medical students want to have children or 5.5% already have children (KBV, 2019). As a result, women in particular, but increasingly men as well, are seeking part-time work to be able to combine family and career.

Furthermore, the next generation of doctors consists of more women. Since 1999, the first year in which more women (51.5%) than men enrolled in medical studies, the proportion of female medical students has increased constantly up to 62.5% in 2019. According to the *German Medical Association* (Bundesärztekammer, BÄK, 2020), now 47.6% of doctors are women.

In conclusion, considerably more physicians need to be trained to obtain the same workforce. So, what do we know then about the health care and workplace situation in which the new generation of junior doctors has to fit in?

1.3 What causes an increased demand for junior doctors?

1.3.1 Demographics and geography

The change in Germany's population structure has resulted in more and more multimorbid elderly people needing outpatient care. It is unclear whether medical expenditures concerning costs and medical staff are merely postponed to a later age and thus the disease burden actually remains the same (morbidity compression theory) or if a longer life span is traded off for a longer phase of chronic diseases (morbidity expansion theory) (Heinz & Jacob, 2012; KBV, 2012, 2015, 2019; Stengler et al., 2012). The trend towards urbanisation and numerous job opportunities there has prompted an excess of doctors in cities and metropolitan areas and a shortage in rural areas (Stengler et al., 2012).

1.3.2 Physician demographics

The baby boomers will retire in the next few years and leave a considerable number of gaps behind. According to current statistics of the BÄK (2020), 20% of physicians were 60 years and older and expected to retire in the next 5–8 years. By the end of 2019, the average age of SHI physicians was 54.3 years whereas in 2009, it was 51.9 years (BÄK, 2020). The junior specialists to follow (30–34 years) and the increase of the total number of physicians by around 2% cannot compensate for the loss (BÄK, 2020).

With the scenario of a possible shortage of SHI physicians and the free choice of a specialty in mind, we wanted to find out how medical schools can influence the specialty choice.

2 Choice of specialty and role of medical schools – our research questions

The curriculum of a medical school in Germany comprises 6 years of study. During the clinical period (3rd–5th year of study), four months of clerkships are mandatory; they can be chosen freely except that one clerkship in general practice is required. In addition to these clerkships, the final year (6th academic year) constitutes a coherent practical phase of 48 weeks. Here the students have to complete 16 weeks of mandatory placements in surgery, internal medicine and an elective subject.

For years, professional associations have been investing considerable effort to strengthen their specialties in the medical curriculum. There has even been a political tug-of-war underway concerning the subjects required in the final year because, according to the *Master Plan for Medical Studies 2020*, general practice should be incorporated as an additional mandatory subject in order to attract more students to this specialty.

Freshly licensed junior doctors in Germany can choose from 34 specialties for their postgraduate training. Considering the competition in recruiting medical graduates, it is very interesting for medical schools to know

- what factors affect medical students or graduates when choosing their specialty and if a medical school has the means to influence this choice,
- how the elective specialty for postgraduate training develops over the course of medical studies,
- when medical students decide on the specialty for their postgraduate training,
- which specialties are mostly chosen and
- if the mandatory placements during the final year had an impact on the specialty choice.

2.1 What factors play a role in choosing a specialty?

To address these questions, we conducted an extensive literature search of the German and international literature. In the US research, a ground-breaking meta-analysis on choosing primary care as specialty was published already in 1995 (Bland et al., 1995). In Germany, research on specialty choice only started around 2009/2010. For a decade now, numerous studies have been published which assess the needs of medical students with regard to their future professional wishes and expectations as well as to their choice of specialty.

Examples include the *Medical Report 2012* (Schwarzer & Fabian, 2012) and the three waves of the *Professional Monitoring for Medical Students* (KBV, 2012, 2015, 2019), the work of Heinz and Jacob (2012), Gibis et al. (2012) and the *Bavarian Graduate Panel* (Falk et al., 2016). Moreover, surveys of medical students have been conducted for individual specialties, especially in general practice (Böhme et al., 2013; Kiolbassa et al,. 2011) and surgery or orthopaedics and trauma surgery (Fröhlich et al., 2018, 2019; Kasch et al., 2016; Osenberg et al., 2010; Schmidt et al., 2016) because of the growing concern about a possible upcoming shortage of these specialties.

Due to the abundance of studies, we decided to concentrate on reviews, meta-analyses and investigations that looked at the process of specialty choice.

A detailed meta-analysis on the US (Bland et al., 1995) proposed a *"model of medical student specialty choice"* (*Bland-Meurer model*) which was confirmed by Querido et al. in 2016 (*BEME Guide No.33*). The meta-analysis included 73 studies focusing on junior doctors who chose to become "primary care physicians", roughly corresponding to general practitioners in Germany. In the *"model of medical student specialty choice"*, factors such as "*student characteristics and views*" and the graduates' "*needs to satisfy*", the "*mission and structure*", the "*faculty composition*", the *"curriculum*" of the medical school and the "*characteristics of each specialty*" all play an important role.

Bland et al. (1995) suggested that general practice is chosen as a specialty more often if a medical school has actively decided to enrol students from rural areas with an interest in general practice. They pointed out that a medical school should have its own department of general practice that is empowered to influence not only the student selection process but also the curriculum. They recommended further to establish a mandatory general practice placement (6–8 weeks), preferably in the third year of study. As the most important factor seemed to be the duration of the mandatory placements, it would be even better to offer a longitudinal course or a separate curriculum track.

Moreover, Bland et al. (1995) stated that students often do not know enough about the specialties or have misconceptions, e.g. about internal medicine.

In focus group interviews, Gebhard and Müller-Hilke (2019) identified the following factors for the choice of a specialty: "*personal skills/personal character*" ("*student characteristics"* in Bland et al., 1995), "*personal experiences*", *"work-life balance"* ("*needs to satisfy"* in Bland et al., 1995), "*role models", "professional perspectives" and "expectations/esteem from outside".* They found that students who are still undecided at the end of their studies focus on family-friendly environments and work-life balance and are influenced by external expectations from family members and friends. This also includes the image of certain specialties conveyed in popular television series.

Another review by Schmidt et al. (2016) focused on the factors that influence medical students in the US to start a surgical career. They identified mentorship and positive role models as two very important factors and addressed the major role of surgical faculty and residents (Erzurum et al., 2000; Quillin et al., 2012).

A positive experience with surgical mentors during a general surgery placement prompted 82% of medical students to choose surgery as specialty (Lindeman et al., 2013). Schmidt et al. (2016, p. 71) state: "*Teaching and mentoring that occurs during procedures, simulations, or in the operating room is the true factor influencing medical students to pursue a career in surgery.*"

Stahn and Harendza (2014) reported similar results in a qualitative study of senior physicians and registrars in internal medicine and laboratory medicine, adding "*extent of patient contact*" as a relevant factor for specialty choice apart from role modelling and mentoring.

Negative "*stereotypes and misconception*" (Schmidt et al., 2016) are other important factors that often hinder students from choosing surgical training. Kozar et al. (2004) reported that fellow students, teachers and the media could also contribute to a negative perception of surgery. Hill et al. (2014) described how the characteristics of surgery – a "*competitive, masculine specialty, requiring sacrifice"* – and the demeanour of surgeons – "*self-confident and intimidating"* – leads to students losing interest in surgery. In a study by Sanfey et al. (2006, p. 1089), "*70% of medical students believed that surgeons did not lead well-balanced lives*" and therefore are discouraged to choose surgery. However, early personal contact to surgeons in clerkships can change this negative impression (Cochran et al., 2005).

Yang et al. (2019) weighed the various factors that influence the choice of a specialty in their review. They concluded that the most important factor is "*academic interest"* in a specialty whereas the level of income plays a much smaller role in the students' choice – unless students have accumulated considerable debt during their studies, which is often the case in the US educational system.

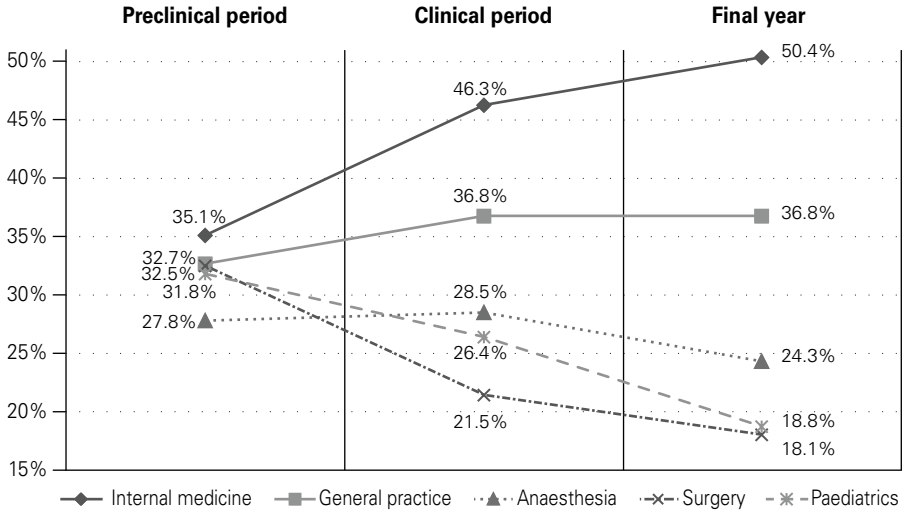
2.2 How does the specialty choice develop over the course of medical studies?

Bland et al. (1995) reported that most students began their medical studies without a concrete idea of what kind of specialty they would like to pursue. Babbott et al. (1988) found that almost 80% of students would have chosen a different specialty before enrolling than they actually chose at graduation. Rabinowitz (1990) reported that only 24% of students who would have chosen general practice at the beginning of their studies actually chose it at graduation. However, students who had the choice between several medical specialties indicated that they rated the ultimately chosen specialty "*moderately inclined to select"* in "*70% of the time"* and "*strongly inclined to select"* in "*37% of the time"* (Carline & Greer, 1991).

Falk et al. (2016) stated that only 9.5% of the 423 graduates had already made their choice of specialty before starting their studies. Indeed, 64.1% made their choice during their studies and 26.5% afterwards. Clinical placements had a major impact on the choice of specialty, e.g. final-year training (77.3%) or clinical clerkships (50.8%). Course content (52.9%) was important, too, and the influence of faculty (15.1%) was somewhat higher than that of parents and relatives (12.5%). Multiple answers were possible. Therefore, the curriculum and the final year, in particular, can have a great impact on the choice of a specialty.

The *Professional Monitoring for Medical Students,* an online survey of the University of Trier in cooperation with the *SHI* and the *Association of Medical Schools* (KBV, 2019), invites all German medical students to participate in the study every 4 years since 2010. Figure 1 shows how the choice of the five most popular specialties develops over the course of medical studies. Up to three specialties could be selected.

Figure 1: Choice of specialties during medical studies



Percentage of students, Professional Monitoring for Medical Students, 2019.

While general practice is more often chosen in the clinical period and final year, paediatrics and adolescent medicine and surgery show a decline during the course of studies. This loss is drastic for surgery: from 32.5% of the students in the preclinical period to 21.5% in the clinical period, the number of students interested in surgery decreases to only 18.1% in the final year. This trend is now proven across all three survey waves in 2010, 2014 and 2018 of the *Professional Monitoring for Medical Students* (KBV, 2012, 2015, 2019). Similar results were reported by Osenberg et al. (2010) in their survey of medical students from Bochum, Germany, in the winter term 2006/2007 (multiple choice of specialties possible): At the beginning of their studies, more than one-third (34.4%) of the students indicated surgery as a desired subject, while this was only the case for 16.5% in the final year.

While some specialties – e.g. paediatrics and surgery – indeed can lose possible future junior doctors in the course of their studies, the survey by Osenberg et al. (2010) showed that interest in internal medicine, urology and ear, nose and throat medicine increased over time.

Let us now take a closer look to the role of practical training placements such as the clinical clerkships or the final year. Can they increase interest in the respective specialties?

2.3 The role of practical placements

Kasch et al. (2016) and Schmidt et al. (2016) pointed out that "*early positive practical experiences*" have a significant effect on the professional interest in a specialty. After a clerkship in orthopaedics and trauma surgery, 67.3% of the students indicated that they intended to choose it as a final-year elective. Among final-year students who finished their mandatory placement in surgery, 49.5% reported both positive and negative influences of the placement on their specialty choice (Fröhlich et al., 2019).

We can resume that for practical placements, the following factors are crucial for a positive evaluation of this period: good integration into the clinical team, acquisition of practical competencies and support and contact to the senior physicians and registrars. Schmidt et al. (2016) accentuated that students should be actively involved, e.g. in leading the camera during operative procedures/laparoscopy. Also one-to-one clerkships increased the interest in surgery (Cook et al., 2015).

These results are supported by those of Gebhard and Müller-Hilke (2019), who identified that *"personal experiences"*, i.e. clerkships, clinical and final-year placements and contact with physicians, are the most important factor in choosing a specialty. Fröhlich et al. (2019) also noted a lack of structure in the clerkships and final-year placements as well as a lack of didactic training in clinical teaching. This can explain why many possible candidates are lost for postgraduate training in surgery.

2.4 When do medical students decide on the specialty for their postgraduate training?

Brooks (1991) asked the same group of students at the end of the preclinical period and at graduation about their career choices. He found that, ultimately, 37% of the students had changed their specialty choice, often from general practice towards surgical specialties.

Two other studies in the US surveyed career preferences at six different points in time during the course of medical studies. Here, 45% of the students had already indicated their chosen specialty at the beginning of their studies. However, half of them had had doubts in between (Zeldow et al., 1992, McLaughlin et al., 1993).

Hochberg et al. (2014) reported that 62% of the residents had already chosen surgery before starting their studies, 13% in preclinical years and 25% during clerkships. Kozar et al. (2004) and Drolet et al. (2014) also described an early choice in second-year medical students.

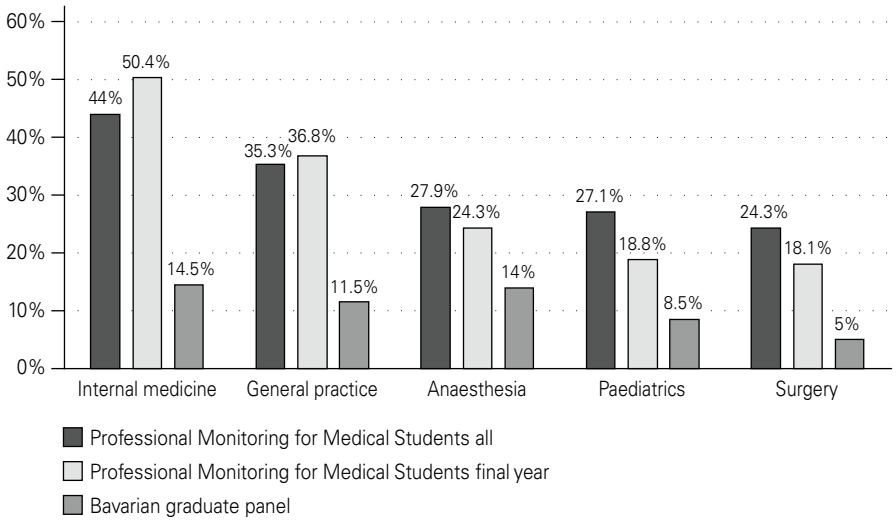
Gebhard and Müller-Hilke (2019) showed for medical students in Rostock, Germany, that about one-third of the first-year students had already decided on a specialty and about three-quarters of the students had chosen a specialty by their final year.

The situation in general practice is different: Kiolbassa et al. (2011) revealed that a choice in favour of general practice was made only towards the end of studies or during early residency.

2.5 Which specialties are notably popular?

Figure 2 shows a ranking of the five most popular specialties elected by medical students during their course of studies – students could select up to three subjects – and the real choice being made after graduation (KBV, 2019; Falk et al., 2016).

Figure 2: Ranking of specialties



Internal medicine and general practice rank first whereas surgery is eventually chosen by only 5% of all graduates. This is very problematic since it is assumed that 10% of a graduating class – about 1,000 surgeons – will be needed (Fröhlich et al., 2018).

In the study by Stengler et al. (2012), young doctors (age < 40 years) without a specialty designation were asked by five *federal state medical associations* in 2007 about their continuing education goals. Here, 3,059 candidates for specialty training participated. The majority (57%) wanted to begin specialty training in the following four areas: general practice 17.7%, internal medicine 16.4%, paediatrics 11.6% and gynaecology 11.7%.

In summary, the situation for general practice is significantly better than for surgery.

2.6 Which impact do mandatory placements during the final year have on specialty choice?

Let us turn back to the final year. To examine the impact that the two mandatory final-year subjects – surgery and internal medicine – have on choosing one of them as a specialty, we analysed the anonymous evaluation data collected from final-year students of the Medical Faculty Mannheim, Germany, before the final year and quarterly after each placement. Answers to the following questions from 2013 to 2020 were included:

- "*If surgery was not a mandatory subject, would you have chosen it as an elective?*" ("*yes/no*")
- "*If internal medicine was not a mandatory subject, would you have chosen it as an elective?*" ("*yes/no*")
- "*I could imagine working in this specialty*". (5-point Likert item with answers (1) "*fully agree*" … (5) "*fully disagree*") We coded the answers with ratings of (1) and (2) as "yes", (4) and (5) as "no".

To determine whether students changed their preference after their final-year placement in internal medicine or surgery, we analysed contingency tables using Chi-squared tests. We calculated Phi as effect size due to the large sample sizes. Phi is interpreted as a small effect at $\varphi \geq 0.07$, a medium effect at $\varphi \geq 0.21$ and a large effect at $\varphi \geq 0.35$.

Furthermore, we compared the groups of students with and without a change in preference using the scores of the scale "final-year training". This scale is the essential part of the "*Mannheim Questionnaire for the evaluation of training conditions and satisfaction with the placement in the final year*" (*Ma-FEZ-PJ*, Schüttpelz-Brauns et al., 2019). The scale consists of 27 items on the quality of the final-year training. Students can rate the items on a five-point Likert scale from (1) "*fully agree*" to (5) "*fully disagree*" or from (1) "*extremely satisfied*" to (5) "*extremely dissatisfied*", depending on the wording of the statement.

To analyse data and compare the groups, we employed one-way analyses of variance with post hoc Scheffé tests. Again, we calculated the effect using eta-square as effect size with $\eta^2 \geq 0.0099$ meaning a small effect, $\eta^2 \geq 0.0588$ a medium effect and $\eta^2 \geq 0.1379$ a large effect.

2.6.1 Results for surgery

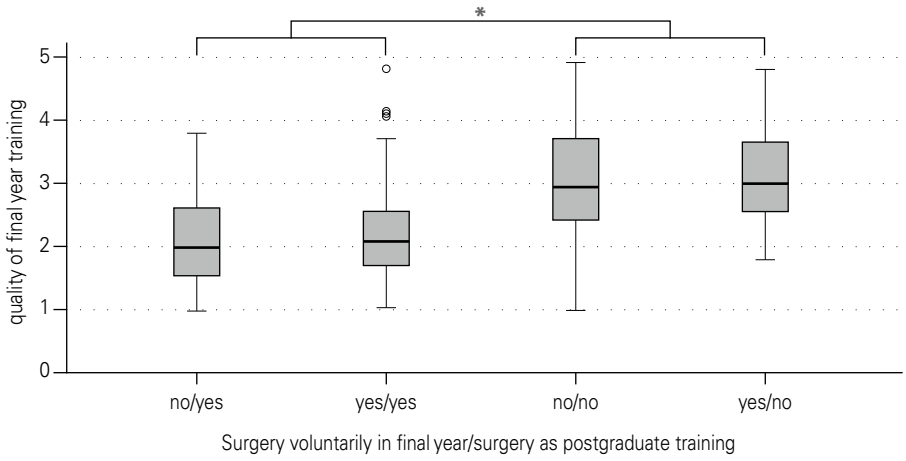
We collected data from 526 students after their placement in surgery but only 370 students answered both questions concerning the voluntariness of the subject in the final year and their specialty preference (see Table 1). Here, 63% of the final-year students did not change their preference towards or against surgery as their future specialty. However, 38% changed their minds (sum > 100% due to rounding). Whether students can imagine becoming a surgeon depends on whether they had chosen this subject voluntarily: $\chi^2(1) = 25.67$, $p < 0.001$; $\varphi = 0.26$, meaning a medium effect.

Table 1: Number and percentage of final-year students voluntarily choosing surgery in the final year in combination with choosing surgery as specialty training

		"I could imagine working in this specialty"		
		Yes	No	Total
"If surgery was not a mandatory subject, would you have chosen it as an elective?"	Yes	85 (23%)	39 (11%)	124 (34%)
	No	100 (27%)	146 (40%)	246 (67%)
Total		**185 (50%)**	**185 (50%)**	**370 (100%)**

As figure 3 shows, we found that students who consider surgery for their postgraduate training (see Table 1) rated the quality of their final-year placement significantly higher than those who were not interested in surgery as a specialty after their final-year placement. Low scores in the scale "final-year training" of *Ma-FEZ-PJ* (Schüttpelz-Brauns et al., 2019) indicate that the quality of the final-year placement was rated high.

Figure 3: Voluntarily choosing surgery as final-year subject and/or as specialty choice in comparison to the quality of the final-year training



* = significant difference between the two groups.

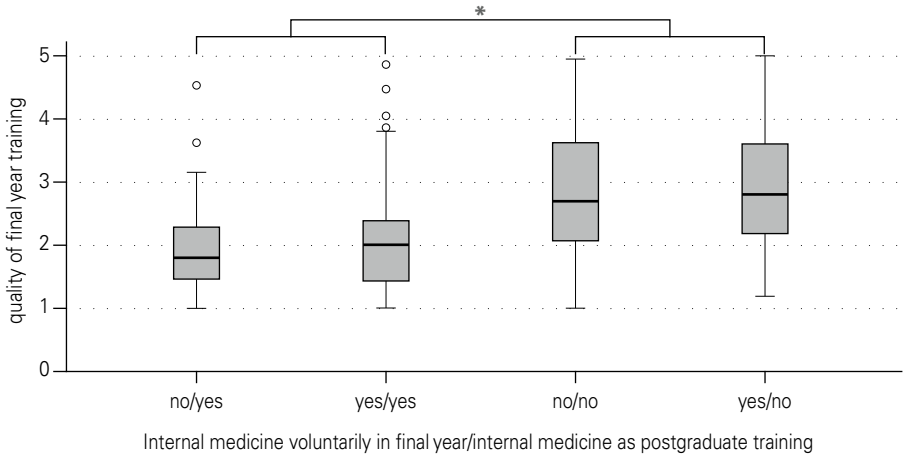
2.6.2 Results for internal medicine

Table 2 shows the results for internal medicine. We collected data from 523 students after their placement in internal medicine. Again, we could only include 379 students who answered both questions concerning the voluntariness of the subject in the final year and their specialty preference. Of the final-year students, 71% did not change their preference towards internal medicine as their future specialty. However, 28% changed their minds (sum >100% due to rounding). Whether students can imagine working in internal medicine depends on whether they would have chosen this subject voluntarily: $\chi^2(1) = 54.97$, $p < 0.001$; $\varphi = 0.38$, meaning a medium effect.

Table 2: Number and percentage of final-year students voluntarily choosing internal medicine as subject in combination with choosing internal medicine as specialty training

		"I could imagine working in this specialty"		
		Yes	**No**	**Total**
"If internal medicine was not a mandatory subject, would you have chosen it as an elective?"	Yes	190 (50%)	47 (12%)	237 (63%)
	No	61 (16%)	81 (21%)	142 (38%)
Total		**251 (66%)**	**128 (34%)**	**379 (100%)**

Figure 4: Voluntarily choosing internal medicine as final-year subject and/or as specialty training in comparison to the quality of the final-year training.



* = significant difference between the two groups.

Figure 4 shows that students who consider internal medicine for their postgraduate training – "*no*" to internal medicine as an elective subject/"*yes*" to internal medicine

as specialty choice and "*yes*" to internal medicine as an elective subject/"*yes*" to internal medicine as specialty choice (see Table 2), respectively – rated the quality of their final-year placement in internal medicine significantly higher than those who were not interested.

The study by Fröhlich et al. in 2019 about final-year placements in surgery points exactly in the same direction: Students who decided to take surgery for postgraduate training or changed their mind towards surgery during their final-year placement were more satisfied with their final-year training.

Our data show that students change their mind concerning specialty choice even in the final year of medical studies and that the effect works in both directions. For example, surgery loses 12% of potential junior doctors after the final-year placement whereas 16% can be attracted through a positive experience during their placement. Internal medicine would be chosen voluntarily by more than half of final-year students, but loses 12% after the placement and attracts 16% of the students.

What we do not know is whether the (new) career preference is eventually chosen after graduation.

Now, let us consider possible measures to increase the preference for certain specialties, especially for surgery.

3 Measures to increase the attractiveness of the specialties – plan of action

In response to the predicted shortage of junior doctors, the major professional societies established junior professional groups (e.g. *Young Internists*, *Forum Surgery*, Achatz, 2013) to bundle the demands of junior doctors. Moreover, they offer a special programme for them and scholarships for medical students attending their annual congresses. The surgical societies now offer a variety of tailored events for interested students: summer schools, career days and preparation courses for final exams are just a few examples.

In the meantime, these initiatives have even reached the *German Doctors' Day (Deutscher Ärztetag),* where a forum was held for the first time in 2019 allowing junior doctors to discuss the future work situation with heads of departments.

Additional marketing campaigns such as "*Don't lose heart*" ("*Nur Mut"*) for surgery or the "*family doctor's campaign"* ("*Hausarztkampagne*") were intended to change the image of these specialties.

3.1 Extracurricular measures at medical schools

In addition to these initiatives, medical schools are developing promising approaches, such as the *specialist debate* at LMU Munich (*Facharztduell*, Welbergen et al., 2014), the "*Cutting Open Day*" ("Aufschneidertag", Kauffels-Sprenger et al., 2019) in Göttingen, the "*Sectio chirurgica"* in Tübingen (Shiozawa et al., 2017) and commented live broadcasts from the operating theatre in Leipzig.

In order to raise the students' interest in surgery, Patel et al. (2013) organised a *Surgery Saturday*, offering training in suturing, knot tying, open instrument identification, operating theatre etiquette and basic laparoscopic skills.

Gebhard and Müller-Hilke (2019) reported that e.g. the Mayo clinic and Columbia University offer career counselling programmes.

Here are some recommendations – following Bland et al. (1995) – that support medical schools in recruiting more junior doctors:

- Give career advice! Bland et al. (1995, p. 637) recommend: "*Establish a career counselling program*."
- Try to get the most out of clinical placements such as the block courses, clerkships and the final-year placements!
- Train doctors to be good teachers/mentors – it should be an honour to teach medical students and not an annoying duty on the side.
- Appoint permanent mentors both in the final year and for specialty training!
- Be aware of being a good role model! Do not consider students in the final year and in clerkships as a burden but as future colleagues.
- Invest in the final-year training and integrate these students into your team – many students make their specialty choice in the final year!
- Give students the opportunity to choose their placements! In the existing medical curriculum most courses are compulsory and there is little room for students to pursue their own interests.

4 Limitations

None of the available surveys of medical students on their future career preferences can be considered representative. The number of participants of the *Professional Monitoring for Medical Students* (KBV, 2019) and the O+U study by Kasch et al. (2016) are high, with almost 14,000 and 9,000 participating students, respectively.

However, in relation to the approximately 94,000 medical students in 2017 respectively 73,400 in 2011 (Statistisches Bundesamt, 2020), the response rate is just 17% (KBV, 2019) and for Kasch et al. (2016) 12%.

It is not clear whether students will accomplish their goals concerning their specialty choice. Bland et al. (1995) stated: "*This confusion as to what students are reporting in studies (their unimpeded preferences or their realistic choices) calls into question the validity of many of the studies of specialty preference stability"* (p. 635).

Most of the German studies included in this work investigate the students' expectations of their future labour situation and preferences, but not realities (*Thomas-Effekt*, KBV, 2019). However, it is important to take the impressions of the final-year students very seriously as they gather authentic work experience.

5 Conclusion

5.1 Conclusion regarding research

Finally, the decision-making process of choosing a specialty is not clear yet. Katz et al. (1984) describe it as "hypothesis testing", i.e. students test their choice against their experience and new information about the specialty. In our view, the final year of medical studies should be considered a "reality check" for future professional work, which helps to choose a specialty.

We did determine, however, that positive experiences in practical placements can increase the preference for the respective specialty. Whether these intentions are realised, however, also depends on the influence of "life-style factors".

Overall, not a single longitudinal study in Germany has linked the development of the specialty choice during the course of medical studies with graduates' final decision to pursue training in a specific specialty. One option would be to draw on student evaluations of medical schools with questions on the specialty choice and linking them to preferably nationwide surveys of graduates as it is done in the US.

According to Gebhard and Müller-Hilke (2019), an initial longitudinal study is planned in Rostock, Germany. This is especially important because the changes put forth by the *Master Plan for Medical Studies 2020* for strengthening general practice should be monitored with regard to the effect on the specialty choice. Furthermore, as mentioned by Querido et al. (2018), we do not know enough about how the factors for choosing a specialty are interlinked and influence each other, and therefore need more qualitative studies on this topic.

5.2 Conclusion concerning the medical curriculum

Positive individual experiences during final-year placements substantially contribute to taking a mandatory subject into consideration for specialty training. Therefore, it is indispensable that clinicians who work in a (mandatory) subject of the final year invest time and effort in a high-quality final-year training – e.g. in mentoring, observing and giving feedback – to attract junior doctors.

The changes for the final year based on the *Master Plan for Medical Studies 2020* – dividing the final year into four quarters and introducing outpatient medicine – should be regarded as a good opportunity for students to focus on their own subjects of interest. Since early practical experience in a subject strengthens the specialty choice, longitudinal placements in surgery should be introduced in clinical studies.

This could help to solve the existing distribution problem across the specialties.

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References

Achatz, G. (2013). Chirurgischer Nachwuchs. Perspektivforum Junge Chirurgen gegründet. *Deutsches Ärzteblatt, 110*(35–36), 1645–1646.

Approbationsordnung für Ärzte. (2002). (BGBl. I p. 2405) Retrieved 31.10.2020 from https://www.gesetze-im-internet.de/_appro_2002/BJNR240500002.html.

Babbott, D., Baldwin, D.C., Jr, Jolly, P., & Williams, D.J. (1988). The stability of early specialty preferences among US medical school graduates in 1983. *JAMA*, *259*(13), 1970–1975.

Bland, C.J., Meurer, L.N., & Maldonado, G. (1995). Determinants of primary care specialty choice: a non-statistical meta-analysis of the literature. *Academic Medicine*, *70*(7), 620–641.

Böhme, K., Kotterer, A., & Simmenroth-Nayda, A. (2013). Allgemeinmedizin im Praktischen Jahr – eine Lösung für Nachwuchsprobleme in der hausärztlichen Versorgung. *Zeitschrift für Allgemeinmedizin*, *89*, 452–458. doi: 10.3238/zfa.2013.0452–0458

Brooks, C.H. (1991). The influence of medical school clinical experiences on career preferences: a multidimensional perspective. *Social science & medicine* (1982), *32*(3), 327–332. https://doi.org/10.1016/0277-9536(91)90111-o

Bundesärztekammer. (2020). *Ärztestatistik zum 31.Dezember 2015-2019* [PDF Document]. Retrieved 10.02.2021 from https://www.bundesaerztekammer.de/ueber-uns/aerztestatistik/aerztestatistik-2019/

Bundesministerium für Bildung und Forschung (BMBF). (2020). *Masterplan Medizinstudium 2020*. Retrieved 14.02.2021 from https://www.bmbf.de/files/2017-03-31_Masterplan%20Beschlusstext.pdf

Carline, J.D., & Greer, T. (1991). Comparing physicians' specialty interests upon entering medical school with their eventual practice specialties. *Academic medicine: journal of the Association of American Medical Colleges, 66*(1), 44–46. https://doi.org/10.1097/00001888-199101000-00013

Cochran, A., Melby, S., & Neumayer, L.A. (2005). An Internet-based survey of factors influencing medical student selection of a general surgery career. *American journal of surgery*, *189*(6), 742–746. https://doi.org/10.1016/j.amjsurg.2005.03.019

Cook, M.R., Yoon, M., Hunter, J., Kwong, K., & Kiraly, L. (2015). A nonmetropolitan surgery clerkship increases interest in a surgical career. *American journal of surgery*, *209*(1), 21–25. https://doi.org/10.1016/j.amjsurg.2014.08.027

Drolet, B.C., Sangisetty, S., Mulvaney, P.M., Ryder, B.A., & Cioffi, W.G. (2014). A mentorship-based preclinical elective increases exposure, confidence, and interest in surgery. *American journal of surgery*, *207*(2), 179–186. https://doi.org/10.1016/j.amjsurg.2013.07.031

Erzurum, V.Z., Obermeyer, R.J., Fecher, A., Thyagarajan, P., Tan, P., Koler, A.K., Hirko, M.K., & Rubin, J.R. (2000). What influences medical students' choice of surgical careers. *Surgery*, *128*(2), 253–256. https://doi.org/10.1067/msy.2000.108214

Falk, S., Reimer, M., Wieschke, J., Heidrich, S., & Bogner, M. (2016): *Bayerische Mediziner Jahrgang 2015: Rückblick aufs Studium, Weiterbildung und Berufsübergang. Tabellenband*. Retrieved 09.02.2021 from https://www.bap.ihf.bayern.de/fileadmin/user_upload/BAP_Dateien/Absolventenjahrgaenge/2013-2014/Tabellenband_MediBAP_2015-16_v04.pdf

Fröhlich, S., Göbel, F., Meder, A., Wirkner, J., Obertacke, U., & Kasch, R. (2019). Chirurgisches Pflichttertial im Praktischen Jahr – das Sprungbrett in die chirurgische Weiterbildung? *Zentralblatt für Chirurgie – Zeitschrift für Allgemeine, Viszeral-, Thorax- und Gefäßchirurgie*, *144*(6), 543–550.

Fröhlich, S., Göbel, F., Meder, A., Wirkner, J., Obertacke, U., & Kasch, R. (2018). Qualität und Zufriedenheit mit der chirurgischen Famulatur aus studentischer Sicht. *Zeitschrift für Orthopädie und Unfallchirurgie*, *156*(06), 639–645. https://doi.org/10.1055/a-0609-6781

Gartmeier, M., Epstein, N., Berberat, P., & Fischer, M.R. (2017). Medizinstudium: Fakten statt Mythen. *Deutsches Ärzteblatt*, *114*(40), 1799–1803.

Gebhard, A., & Müller-Hilke, B. (2019). Criteria of medical students for the selection of their future clinical specialisation: a cross-sectional survey at the Medical Faculty of Rostock. *GMS journal for medical education*, *36*(6), Doc76. doi:10.3205/zma001284

Gibis, B., Heinz, A., Jacob, R., & Müller, C.-H. (2012). Berufserwartungen von Medizinstudierenden: Ergebnisse einer bundesweiten Befragung. *Deutsches Ärzteblatt*, *109*(18), 327–332.

Heinz, A., & Jacob, R. (2012). Medizinstudenten und ihre Berufsperspektiven. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 55*(2), 245–253. doi:10.1007/s00103-011-1413-z

Hibbeler, B. (2012). Praktisches Jahr: Jagd auf den Nachwuchs. *Deutsches Ärzteblatt 109*(14), 677.

Hill, E., Bowman, K.A., Stalmeijer, R.E., Solomon, Y., & Dornan, T. (2014). Can I cut it? Medical students' perceptions of surgeons and surgical careers. *American journal of surgery*, *208*(5), 860–867. https://doi.org/10.1016/j.amjsurg.2014.04.016

Hochberg, M.S., Billig, J., Berman, R.S., Kalet, A.L., Zabar, S.R., Fox, J.R., & Pachter, H.L. (2014). When surgeons decide to become surgeons: new opportunities for surgical education. *American journal of surgery*, *207*(2), 194–200. https://doi.org/10.1016/j.amjsurg.2013.10.010

Institut für medizinische und pharmazeutische Prüfungsfragen (IMPP). (2020). *Ergebnisbericht Ärztliche Prüfung Frühjahr 2020*. Retrieved 14.02.2021 from https://www.impp.de/informationen/berichte/ergebnisberichte/medizin.html

Katz, L.A., Sarnacki, R.E., & Schimpfhauser, F. (1984). The role of negative factors in changes in career selection by medical students. *Journal of medical education*, *59*(4), 285–290. https://doi.org/10.1097/00001888-198404000-00001

Kasch, R., Wirkner, J., Meder A., Abert E., Abert M., Schulz A.P., Walcher F., Gümbel D., Obertacke U., Schwanitz P., & Merk H. (2016). Wer bleibt nach einer Famulatur in Orthopädie und Unfallchirurgie dem Fachbereich treu? Ergebnisse einer bundesweiten Umfrage. *Zeitschrift für Orthopädie und Unfallchirurgie*, *154*(04), 352–358. doi: 10.1055/s-0042-104119

Kassenärztliche Bundesvereinigung (KBV). (2012). *Berufsmonitoring Medizinstudenten 2010 – Ergebnisse einer bundesweiten Befragung.* Köln: Deutscher Ärzteverlag.

Kassenärztliche Bundesvereinigung. (2015). *Berufsmonitoring Medizinstudierende 2014 – Ergebnisse einer bundesweiten Befragung* [PDF-Document]. https://www.kbv.de/media/sp/2015-04-08_Berufsmonitoring_2014_web.pdf

Kassenärztliche Bundesvereinigung. (2019). *Berufsmonitoring Medizinstudierende 2018 – Ergebnisse einer bundesweiten Befragung* [PDF-Document]. https://www.kbv.de/media/sp/Berufsmonitoring_Medizinstudierende_2018.pdf

Kauffels-Sprenger, A., Lehmann, W., Kutschka, I., Trojan, L., & Ghadimi, M. (2019). Freude an der Chirurgie – Einblicke gewähren, Begeisterung wecken. *Zentralblatt für Chirurgie – Zeitschrift für Allgemeine, Viszeral-, Thorax- und Gefäßchirurgie*, *144*(6), 614–615.

Kiolbassa, K., Miksch, A., Hermann, K., Loh, A., Szecsenyi, J., Joos, S., & Goetz, K. (2011). Becoming a general practitioner – Which factors have most impact on career choice of medical students? *BMC family practice*, *12*(1), 25–32.

Kopf, S. (2014). Was die jungen Wilden wollen. Die Generation Y verändert die Krankenhäuser und das Arztsein gleich mit. *Deutsches Ärzteblatt, 111*(1–2), 2.

Kopetsch, T. (2010). *Dem deutschen Gesundheitssystem gehen die Ärzte aus. Studie zur Altersstruktur- und Arztzahlentwicklung*. https://cdn.aerzteblatt.de/download/files/2010/09/down148303.pdf

Kozar, R.A., Anderson, K.D., Escobar-Chaves, S.L., Thiel, M.A., & Brundage, S.I. (2004). Preclinical students: who are surgeons?. *The Journal of surgical research*, *119*(2), 113–116. https://doi.org/10.1016/j.jss.2004.03.024

Lindeman, B.M., Lipsett, P.A., Alseidi, A., & Lidor, A.O. (2013). Medical student subinternships in surgery: characterization and needs assessment. *American journal of surgery*, *205*(2), 175–181. https://doi.org/10.1016/j.amjsurg.2012.10.008

McLaughlin, M.A., Daugherty, S.R., Rose, W.H., & Goodman, L.J. (1993). Specialty choice during the clinical years: a prospective study. *Academic medicine: journal of the Association of American Medical Colleges*, *68*(10), 55–57. https://doi.org/10.1097/00001888-199310000-00045

Medizinischer Fakultätentag der Bundesrepublik Deutschland (MFT). (2010, April 16). *Sinkende Abbrecher- und steigende Absolventenzahlen bei Medizinern* [Press release]. http://www.mft-online.de/presse-standpunkte/pressemitteilungen/2010/-sinkende-abbrecher--und-steigende-absolventenzahlen-bei-medizinern

Mittlmeier, T., Bonnaire, F., Grützner, P.A., Lill, H., Matthes, G., Prokop, A., Seifert, J., Voigt, C., Walcher, F., Wölfle, C., & Siebert, H. (2010). Der Weg zum Unfallchirurgen. Situationsanalyse und Konzepte zur Nachwuchsförderung in der Unfallchirurgie im Umfeld des neuen gemeinsamen Fachs Orthopädie/Unfallchirurgie – Teil I. *Der Unfallchirurg*, *113*(6), 504–512.

Osenberg, D., Huenges, B., Klock, M., Huenges, J., Weismann, N., & Rusche, H. (2010). Wer wird denn noch Chirurg? *Deutsche Gesellschaft für Unfallchirurgie e. V. Mitteilungen und Nachrichten*,*62,* 79–86.

Patel, M.S., Mowlds, D.S., Khalsa, B., Foe-Parker, J.E., Rama, A., Jafari, F., Whealon, M.D., Salibian, A., Hoyt, D.B., Stamos, M.J., Endres, J.E., & Smith, B.R. (2013). Early intervention to promote medical student interest in surgery and the surgical subspecialties. *Journal of surgical education*, *70*(1), 81–86. https://doi.org/10.1016/j.jsurg.2012.09.001

Querido, S.J., Vergouw, D., Wigersma, L., Batenburg, R.S., de Rond, M.E., & ten Cate, O.T. (2016). Dynamics of career choice among students in undergraduate medical courses. A BEME systematic review. BEME Guide No. 33. *Medical teacher*, *38*(1), 18–29. doi: 10.3109/0142159X.2015.1074990

Querido, S., van den Broek, S., de Rond, M., Wigersma, L., & ten Cate, O. (2018). Factors affecting senior medical students' career choice. *International Journal of Medical Education, 9,* 332–339. doi: 10.5116/ijme.5c14.de75

Quillin, R.C., 3rd, Pritts, T.A., Davis, B.R., Hanseman, D., Collins, J.M., Athota, K.P., Edwards, M.J., & Tevar, A.D. (2012). Surgeons underestimate their influence on medical students entering surgery. *The Journal of surgical research*, *177*(2), 201–206. https://doi.org/10.1016/j.jss.2012.05.064

Rabinowitz, H.K. (1990). The change in specialty preference by medical students over time: an analysis of students who prefer family medicine. *Family medicine*, 22(1), 62–63.

Sanfey, H.A., Saalwachter-Schulman, A.R., Nyhof-Young, J.M., Eidelson, B., & Mann, B.D. (2006). Influences on medical student career choice: gender or generation? *Archives of surgery (Chicago, Ill.: 1960)*, *141*(11), 1086–1094. https://doi.org/10.1001/archsurg.141.11.1086

Schmidt, L.E., Cooper, C.A., & Guo, W.A. (2016). Factors influencing US medical students' decision to pursue surgery. *Journal of Surgical Research*, *203*(1), 64–74.

Schüttpelz-Brauns, K., Narciß, E., Giesler, M., & Obertacke, U. (2019). Erfassung der Zufriedenheit mit dem Einsatz im Praktischen Jahr (Ma-FEZ-PJ) zur Qualitätssicherung der Lehre im Praktischen Jahr – Psychometrie eines Selbsteinschätzungsfragebogens. *Zentralblatt für Chirurgie*, *144*(06), 580–586.

Schwarzer, A., & Fabian, G. (2012). *Medizinerreport 2012 – Berufsstart und Berufsverlauf von Humanmedizinerinnen und Humanmedizinern*. HIS: Datenbericht.

Shiozawa, T., Butz, B., Herlan, S., Kramer, A., & Hirt, B. (2017). Interactive anatomical and surgical live stream lectures improve students' academic performance in applied clinical anatomy. *Anatomical sciences education*, *10*(1), 46–52. https://doi.org/10.1002/ase.1623

Stahn, B., & Harendza, S. (2014). Role models play the greatest role – a qualitative study on reasons for choosing postgraduate training at a university hospital. *GMS Zeitschrift für Medizinische Ausbildung*, *31*(4), Doc45. doi: 10.3205/zma000937

Statistisches Bundesamt. (2020). *Hochschulen. Studierende insgesamt und Studierende Deutsche im Studienfach Medizin (Allgemein-Medizin) nach Geschlecht*. Retrieved 14.02.2021 from https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Tabellen/lrbil05.htm

Stengler, K., Heider, D., Roick, C., Günther, O.H., Riedel-Heller, S., & König, H.H. (2012). Weiterbildungsziel und Niederlassungsentscheidung bei zukünftigen Fachärztinnen und Fachärzten in Deutschland. Eine genderspezifische Analyse. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz*, *55*(1), 121–128. https://doi.org/10.1007/s00103-011-1397-8

Welbergen, L., Pinilla, S., Pander, T., Gradel, M., von der Borch, P., Fischer, M.R., & Dimitriadis, K. (2014) Das FacharztDuell: Innovative Karriereplanung in der Medizin. *GMS Zeitschrift für Medizinische Ausbildung, 31*(2), Doc17. doi: 10.3205/zma000909

Yang, Y., Li, J., Wu, X., Wang, J., Li, W., Zhu, Y., Chen, C., & Lin, H. (2019). Factors influencing subspecialty choice among medical students: a systematic review and meta-analysis. *BMJ Open*, *9*(3), e02209. doi:10.1136/bmjopen-2018-022097

Zeldow, P.B., Preston, R.C., & Daugherty, S.R. (1992). The decision to enter a medical specialty: timing and stability. *Medical education*, 26(4), 327–332. https://doi.org/10.1111/j.1365-2923.1992.tb00177.x

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A primer in resilience training for German medical students – A necessary step in building a resilient healthcare workforce

Jan Kiesewetter, Bria Dimke, Johanna Huber

Resilience training in the higher education context is important, especially for future workplaces that are prone to burnout. However, little is known about whether and how resilience can be trained. In this study, we present a preliminary evaluation of a resilience training for health care professionals and medical students. To validate the training's effects, we utilised an adapted version of the Maslach Burnout Inventory – Human Services Scale (MBI-HSS). A repeated measures ANOVA showed that the training sessions did significantly affect participants' MBI-HSS scores with a large effect. Implications for resilience research and training to build a more resilient healthcare workforce are discussed in the article.

1 Background on resilience in healthcare

Resilience is a widely-used catchphrase that has gained momentum and recognition in recent years. It is commonly used to describe resistance to the psychological strains of life. Especially during the current COVID-19 pandemic, it seems more important than ever for healthcare workers to maintain a high degree of functionality. Resilience holds promise to help curb the negative effects of burnout, thus resulting in less health impairment despite stress (Grossman et al., 2004), higher work satisfaction (Shanafelt et al., 2015) and last but not least higher work performance (Loehr, Loehr, & Schwartz, 2005). However, little is known scientifically about the resilience status of the modern workforce, and specifically whether and how resilience can be improved. Our article presents a short preliminary evaluation of resilience training for health care professionals and medical students (Kiesewetter & Dimke, 2018). Before reporting the results, we first take a look at the scientific constructs related to resilience that have been under investigation a lot longer: burnout and stress among medical students, physicians and healthcare staff. We then present the scarce evidence on resilience.

1.1 Physician burnout

Physicians and nursing staff have been found to be prone to burnout (Buser, Schneller, & Wildgrube, 2007; Schüler & Dietz, 2004). Physicians' social behaviour and attitudes towards their job and patients have been shown to change due to their employment of non-functioning coping mechanisms (Möller, Laux, Deister, & Schulte-Körne, 2013;

Schüler & Dietz, 2004). In studies with nurses, general impairment in quality of care has been observed as well as medication errors (Maiden, Georges, & Connelly, 2011). These can also be attributed to non-functioning coping mechanisms for difficult situations and emotional blunting. The consequences for burnt-out staff and employers are grave and include decreased job performance (Parker & Kulik, 1995), reduced job commitment (Cherniss, 2016) and stress-related health problems (Maslach, Schaufeli, & Leiter, 2001). For medical students, a recent review reports burnout rates between 27% and 75%, a wide range with a great deal of regional variance. Overall burnout prevalence is often measured with the Maslach Burnout Inventory, which includes the subcomponents emotional exhaustion, depersonalisation and low personal accomplishment. The prevalence of these three subcomponents range from 0% to 86%, 0% to 89.9%, and 0% to 87.1%, respectively (Rotenstein et al., 2018). No studies from Germany were included in this review. In a German study with data from 2008, final-year medical students reported a clinically-relevant burnout rate of 20% and moderate burnout scores across the whole sample (Koehl-Hackert et al., 2012). The sample was drawn from one city. In addition, the German medical education system has undergone several changes since 2008, so it is difficult to say how representative the data is for today's medical student population.

1.2 Stress in medical school

In the field of medical education, little is known about students' coping mechanisms. It is known that stress among medical students is rather high, with dangerously high stress levels between 21% and 90% reported (Fares, Al Tabosh, Saadeddin, El Mouhayyar, & Aridi, 2016). However, students' diagnostic accuracy for difficult patients showing disruptive behaviour was found to be lower than for difficult patients showing friendly behaviour (Hege et al., 2018). The reason, again, might lie in non-functioning coping mechanisms, which impair working memory capacity, an effect that has been long known in cognitive psychology experiments (Eysenck, 1985).

Summarising results for burnout and stress among medical students, physicians and healthcare staff, we have found evidence of what we call the burnout–workload circle. If physicians, medical students and healthcare staff suffer from dangerously high rates of burnout and stress, higher rates of absenteeism and health-related problems are likely. This might in turn further increase workload among the remaining staff, repeating the negative cycle. Due to high workload, the quality of health care (diagnoses, care, patient satisfaction) declines. Therefore, scientific and public attention has been shifting towards resilience as a potential solution to avoid burnout and stress before this negative dynamic emerges.

1.3 Resilience in healthcare staff

Resilience is defined in a multitude of ways. Some researchers think of resilience as a sense of flexibility or adaptability (Jackson, Firtko, & Edenborough, 2007). Others define resilience as an individual's set of skills and attributes that grant them "*the ability to succeed, live, and develop in a positive way despite stress or adversity*" (Cyrulnik, 2009, p. 21). Because of resilience's dynamic nature, it differs from related traits such as "mental toughness" or "hardiness" (Coulter, Mallett, & Gucciardi, 2010).

As research shows, resilience can be learned and nurtured through training and practice (Zautra, Hall, & Murray, 2010). In the field of healthcare and healthcare providers' education, it is especially necessary to foster and maintain a level of resilience. How can one offer their best services if they are not operating as their best selves? Building a sense of resilience is clearly appealing; higher resilience can lead to a decreased occurrence of burnout (Howe, Smajdor, & Stöckl, 2012). Resilience also helps circumvent issues such as impaired concentration, increased cynicism, undermined professional development, and jeopardised care for patients (Dunn, Iglewicz, & Moutier, 2008).

In order to provide a broader range of trainings, we need to identify whether medical students' resilience can indeed be positively influenced. Therefore, in our two-part study, we sought to evaluate whether students' burnout scores decrease after a standardised resilience training.

2 Methods to evaluate the resilience training for medical students and healthcare professionals

In designing the resilience training, we conducted a literature search and adapted evidence-based training interventions from cognitive behavioural group therapy to fit the unique needs of medical students. The overall training programme encompasses a standardised five-week, 10-hour curriculum in resilience (Kiesewetter & Dimke, 2018). The training provides students with techniques and strategies for managing strong emotions, establishing mindfulness practices, increasing their self-compassion, separating their emotions and patients' emotions, and fostering a work-life harmony. We have outlined the training in the supplemental material. A sample activity from the training is so-called emotional speed dating. During the emotional speed dating, pairs of students sit across from each other and ask each other six questions in a specific order. The questions are designed in a way to have students open up about their emotions during patient encounters. The learning objectives for this activity is that students learn that A) it is normal to experience patients' emotions and have their own emotions as well and B) it is normal to struggle with some of these emotions. After

the activity, the whole group can discuss how to deal with emotions in a professional way to remain mentally healthy. The details of the activity have been published in Medical Education (Kiesewetter & Dimke, 2020).

To validate the training's effects, we applied an adapted version of the Maslach Burnout Inventory-Human Services Scale (MBI-HSS); MBI-HSS is a psychometric scale designed by Maslach, Jackson, Leiter, Schaufeli, and Schwab (1986). The MBI-HSS is designed to assess three subcomponents of burnout: emotional exhaustion, depersonalisation, and diminished sense of personal accomplishment.

The original MBI-HSS contains 22 items measuring the three subcomponents of burnout. Of these, we chose to include 16 items because the other items did not seem to fit the student context (Vanheule, Rosseel, & Vlerick, 2007). Items are written in the form of statements about personal feelings such as "I feel frustrated from my work". Participants complete the scale by answering items in terms of the frequency with which they have personally experienced a given feeling or phenomenon. Answers are given on a 7-point Likert scale ranging from 0 = never, to 6 = every day (ibid.).

Design: Second- to sixth-year medical students at LMU Munich were invited to sign up for the 10-hour resilience training for course credit. Participation was voluntary. Students were required to answer the MBI-HSS before the first and after the final training session. All participants gave their consent to take part in the study.

3 Results – What we train when we train resilience

We trained four training cohorts according to the training manual (N = 31 students, 70% female, mean age M = 23.5, SD = 4.1). Participants completed the MBI-HSS prior to the first and after the last training session. Data could be analysed only for 18 students who were present during all training sessions. The MBI-HSS was analysed separately for the three subcomponents of burnout: emotional exhaustion (EE), depersonalisation (DP), and diminished sense of personal accomplishment (PA). All three subcomponents' reliability was tested (Cronbach's α EE = .85, Cronbach's αDP = .62, Cronbach's α PA = .50). A repeated measures ANOVA showed that the trainings did significantly affect participants' MBI-HSS scale scores (pre vs. post) ($F(2;34) = 163.53$, $p < .01$, $\eta^2 = .90$) with a large effect. A post-hoc comparison of this interaction revealed that the pre to post difference for EE (M = 1.52, SD = 3.13) and PA (pre-post difference M = 1.28, SD = 2.02) were significant, while the difference for DP was not significant (pre-post difference M = .06, SD = 1.70).

4 A primer on resilience training in medical school – an important first step, but many questions remain unanswered

We conducted a manual-based resiliency training among medical students (Kiesewetter & Dimke, 2018) and investigated whether the training would have an impact on their burnout scores. Indeed, we found that two of the three burnout subscales did decrease after the training: emotional exhaustion and diminished sense of personal accomplishment. In other words, students felt less emotionally exhausted and experienced a higher sense of personal accomplishment after the training. The depersonalisation subscale was barely affected by the training. This might be due to the short timeframe of the intervention. As students at various stages of their medical education participated in the training, participants might not have felt especially depersonalised prior to the training, as empathy declines over the course of medical school (Neumann et al., 2011). Further, the reliability of the depersonalisation and diminished sense of personal accomplishment subscales was rather low, which might be due to the small overall sample size. Nonetheless, the divergent results for the three subscales indicate that our approach of assessing burnout in a highly differentiated manner paid off. However, in future studies we will also assess medical students' resiliency in a more direct manner with the Connor-Davidson Resilience Scale (Sarubin et al., 2015; Kiesewetter & Huber, in print).

Medicine does entail negative feelings by both physicians and patients (Ofri, 2013), and being able to deal with failure is one of the core components of a resilient healthcare workforce (Wears & Wu, 2002). More research is needed to investigate students' coping mechanisms in order to generate evidence for the external validity of the trainings' effects. Perhaps a qualitative study could shed light on the coping mechanisms students already use in order to design more customised training interventions.

Medical educators should strive towards a more uniform, standardised implementation of resilience trainings in their medical schools – rather than waiting for students or physicians to develop resiliency as a result of negative experiences. Targeted resiliency education, like the training we investigated, might help to build resiliency in continuing medical education (Tempski, Martins, & Paro, 2012).

Subsequent studies may choose to incorporate resilience training into more formalised educational structures or transfer it to an online course or flipped classroom format. The present study recruited participants on a voluntary basis and rewarded them with course credit upon completion of the training. Without incentives such as a formal grade or a full semester's worth of classes, it is possible that participants were not as deeply engaged in the content as desired. We experienced a substantial level of dropout from participants who attended the first session (N = 32) to the final data set,

which only considered participants attending all sessions (N = 18). Incentivising participation with a formal grade or extending the training to a full semester may help to curb this dropout rate and encourage course attendance. Upon asking students why they did not attend class more regularly, they unanimously reported that they had other required courses during the same time window and they wished they could have attended.

More research is needed to assess the coping mechanisms we trained and the long-term effects of the training we provided. It would also be interesting to adapt and provide the training in continuing medical education or to other human services professionals such as teachers, social workers, childcare workers etc. The training itself has proven to be a feasible method of promoting resiliency in medical schools and we invite other medical schools to utilise the training. We invite medical schools or other higher education programmes to contact us if they plan to apply the training and will gladly provide them with our assessment instrument to further validate the training.

As a result of the growing need and possibilities for training medical students' resiliency, there is also a growing need to provide educators with tools for facilitating resiliency trainings. We know little about higher education staff's resilience levels education (Gold, 1984) and even less about their ability to teach courses whose content is derived from cognitive behavioural group therapy. Since some of the course content might trigger emotional responses, it should be ensured that instructors can deal with these responses and know whether and when to offer further support and guidance or where to seek help. Our resilience trainings were facilitated by experienced trainers with a psychotherapy background. The necessary knowledge could be provided to other (medical) educators in train-the-trainer workshops.

There is a growing need to conduct resilience trainings not only in medical education, but also in other fields within higher education. Many parts of the training evaluated here can easily be adopted or adapted to other professions. In particularly, teachers, social workers, nursery school teachers or other human services professionals known to be prone to burnout (Burke & Greenglass, 1988; Chang, 2009) could benefit from the training.

4.1 Limitations of our study

We are aware of the small sample analysed with regard to our training programme. However, the effects for two of the subscales were significant and the two of the measurements were sufficiently reliable. Nonetheless, the differentiated evaluation showed us what our training does and does not train. Obviously, a much larger sample is needed with more trainings and trainers and other measurements like the

Connor-Davidson Resilience Scale (Sarubin et al., 2015) in order to replicate and potentially generalise the effects.

4.2 Conclusions

Gaining increased insight and promoting resiliency makes medical students and healthcare professionals alike better equipped to begin and expand resilience practice (Howe, Smajdor, & Stöckl, 2012). In turn, greater resilience and functional coping strategies could lead to better diagnostic accuracy, fewer unnecessary medical assessments and laboratory procedures, and fewer cases of physician burnout. In short, building resiliency practices in more medical schools would be beneficial not only for practitioners, but also for patients.

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References

Burke, R. J., & Greenglass, E. R. (1988). Career orientations and psychological burnout in teachers. *Psychological reports, 63*(1), 107–116.

Buser, K., Schneller, T., & Wildgrube, K. (2007). *Medizinische Psychologie, medizinische Soziologie: Kurzlehrbuch zum Gegenstandskatalog* (6th ed.). Munich/Jena: Elsevier, Urban&FischerVerlag.

Chang, M.-L. (2009). An appraisal perspective of teacher burnout: Examining the emotional work of teachers. *Educational psychology review, 21*(3), 193–218.

Cherniss, C. (2016). *Beyond burnout: Helping teachers, nurses, therapists and lawyers recover from stress and disillusionment*. London/New York: Routledge.

Coulter, T. J., Mallett, C. J., & Gucciardi, D. F. (2010). Understanding mental toughness in Australian soccer: Perceptions of players, parents, and coaches. *Journal of Sports Sciences, 28*(7), 699–716.

Cyrulnik, B. (2009). *Resilience: How to Gain Strength from Childhood Adversity*. London: Penguin.

Dunn, L. B., Iglewicz, A., & Moutier, C. (2008). A conceptual model of medical student well-being: promoting resilience and preventing burnout. *Academic Psychiatry, 32*(1), 44–53.

Eysenck, M. W. (1985). Anxiety and cognitive-task performance. *Personality and Individual Differences, 6*(5), 579–586.

Fares, J., Al Tabosh, H., Saadeddin, Z., El Mouhayyar, C., & Aridi, H. (2016). Stress, burnout and coping strategies in preclinical medical students. *North American journal of medical sciences, 8*(2), 75.

Gold, Y. (1984). Burnout: A major problem for the teaching profession. *Education, 104*(3), 271–274.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of psychosomatic research, 57*(1), 35–43.

Hege, I., Dietl, A., Kiesewetter, J., Schelling, J., & Kiesewetter, I. (2018). How to tell a patient's story? Influence of the case narrative design on the clinical reasoning process in virtual patients. *Medical teacher, 40*(7), 736–742.

Howe, A., Smajdor, A., & Stöckl, A. (2012). Towards an understanding of resilience and its relevance to medical training. *Medical education, 46*(4), 349–356.

Jackson, D., Firtko, A., & Edenborough, M. (2007). Personal resilience as a strategy for surviving and thriving in the face of workplace adversity: a literature review. *Journal of advanced nursing, 60*(1), 1–9.

Kiesewetter, J., & Dimke, B. (2018). *Resilience training for health care professionals and medical students: An instructional manual*. Independently published.

Kiesewetter, J., & Dimke, B. (2020). Emotional speed-dating as a part of medical students' resilience training. *Medical Education, 54*(4), 473–474. doi:10.1111/medu.14094

Kieswetter, J., & Huber, J. (in print). A primer of an in-depth resilience status for German medical graduates. Results of a cross-sectional survey on the status quo of resilience among graduates of human medicine in Bavaria, Germany – a necessary step in building an emotionally equipped healthcare workforce. *BMC Medical Education.*

Koehl-Hackert, N., Schultz, J.-H., Nikendei, C., Möltner, A., Gedrose, B., van den Bussche, H., & Jünger, J. (2012). Belastet in den Beruf – Empathie und Burnout bei Medizinstudierenden am Ende des Praktischen Jahres. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen, 106*(2), 116–124.

Loehr, J., Loehr, J.E., & Schwartz, T. (2005). *The power of full engagement: Managing energy, not time, is the key to high performance and personal renewal*. New York: Simon and Schuster.

Maiden, J., Georges, J.M., & Connelly, C.D. (2011). Moral distress, compassion fatigue, and perceptions about medication errors in certified critical care nurses. *Dimensions of Critical Care Nursing, 30*(6), 339–345.

Maslach, C., Jackson, S.E., Leiter, M.P., Schaufeli, W.B., & Schwab, R.L. (1986). Maslach burnout inventory manual. Palo Alto, CA: Consulting psychologists press.

Maslach, C., Schaufeli, W.B., & Leiter, M.P. (2001). Job burnout. *Annual review of psychology, 52*(1), 397–422.

Möller, H.-J., Laux, G., Deister, A., & Schulte-Körne, G. (2013). Psychiatrie, Psychosomatik und Psychotherapie. Stuttgart: Thieme.

Neumann, M., Edelhäuser, F., Tauschel, D., Fischer, M.R., Wirtz, M., Woopen, C., … Scheffer, C. (2011). Empathy decline and its reasons: a systematic review of studies with medical students and residents. *Academic medicine, 86*(8), 996–1009.

Ofri, D. (2013). What doctors feel: how emotions affect the practice of medicine. Boston: Beacon Press.

Parker, P.A., & Kulik, J.A. (1995). Burnout, self- and supervisor-rated job performance, and absenteeism among nurses. *Journal of Behavioral Medicine, 18*(6), 581–599.

Rotenstein, L.S., Torre, M., Ramos, M.A., Rosales, R.C., Guille, C., Sen, S., & Mata, D.A. (2018). Prevalence of burnout among physicians: a systematic review. *JAMA, 320*(11), 1131–1150.

Sarubin, N., Gutt, D., Giegling, I., Bühner, M., Hilbert, S., Krähenmann, O., … Rujescu, D. (2015). Erste Analyse der psychometrischen Eigenschaften und Struktur der deutschsprachigen 10- und 25-Item Version der Connor-Davidson Resilience Scale (CD-RISC). *Zeitschrift für Gesundheitspsychologie 23*(3), 112–122.

Schüler, J., & Dietz, F. (2004). Kurzlehrbuch Medizinische Psychologie und Soziologie. Stuttgart: Georg Thieme Verlag.

Shanafelt, T.D., Hasan, O., Dyrbye, L.N., Sinsky, C., Satele, D., Sloan, J., & West, C.P. (2015). Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. Paper presented at the Mayo Clinic Proceedings.

Tempski, P., Martins, M.A., & Paro, H.B. (2012). Teaching and learning resilience: a new agenda in medical education. *Medical Education, 46*(4), 345–346.

Vanheule, S., Rosseel, Y., & Vlerick, P. (2007). The factorial validity and measurement invariance of the Maslach Burnout Inventory for human services. *Stress and Health: Journal of the International Society for the Investigation of Stress, 23*(2), 87–91.

Wears, R.L., & Wu, A.W. (2002). Dealing with failure: the aftermath of errors and adverse events. *Annals of emergency medicine, 39*(3), 344–346.

Zautra, A.J., Hall, J.S., & Murray, K.E. (2010). A new definition of health for people and communities. In J.R. Reich, A.J. Zautra, & J.S. Hall (Eds.), *Handbook of Adult Resilience* (pp. 3–30). New York: Guilford.

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Supplemental Material:

Overview of the resilience training for health care professionals and medical students

The training manual targets an audience of 10–15 medical students and healthcare professionals. The manual's content is designed to be taught over a span of 5 to 10 sessions if time allows. Sessions generally last about two hours and include suggested take-home tasks. In addition, learning goals for each module are provided.

Module 1: Time and energy management.

To start the training, Model 1 focuses on time and energy management.

- Introduces the highly tangible and relevant topic of time and energy management; can be discussed openly and easily by participants new to the topic
- Module 1 includes practices and suggestions for energy management. These are vital to create meaning, maintain longevity, and improve performance both in and out of the workplace

Module 2: Beginning a mindfulness practice

Module 2 aims to incorporate a mindfulness practice into participants' lives and develop this skill set as a means of dealing with life's more stressful times.

- Introduces key pillars of resilience: adaptability, self-control, self-sufficiency, persistence, and optimism
- General and individual mindfulness practices and suggestions are included

Module 3: Understanding achievement emotions

Module 3 places emphasis on so-called achievement emotions and sources of self-concept.

- Introduces sources of self-concept: judgements against a standard, social comparisons, past experiences, and reflected appraisals from significant others along with their implications
- Practices and suggestions for dealing with achievement emotions and approach vs. avoidance mindsets are discussed

Module 4: Managing strong emotions

Module 4 focuses on participants' abilities to identify, manage, and release any frustration linked to dealing with strong emotions and setbacks.

- Developing and practising effective coping strategies to enable participants to move forward more easily following potential setbacks
- Three different techniques to be used when a strong emotion arises: one short-term, one medium-term, and one long-term

Module 5: Harmonising work and life roles

The fifth training module centers on finding and creating harmony between one's obligations as a professional and life outside the clinic/university

- Reflect on their purpose and mission as healthcare professionals.
- Work-life harmonisation strategies are first introduced on a broad meta level and are subsequently scaled down to one's daily activities
- Outlook to practising leadership in medicine

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The Munich Research Competence Scale: Research competence among doctoral candidates and graduates in medicine. Results from the second wave of the Bavarian Graduate Study in Medicine

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Research education in medicine has been under discussion for quite some time, both to assess the status quo and to inform efforts to improve it. A newly developed scale of self-assessed research competences, which builds on a concept of medical research competences and reflects core aspects of reform goals, was piloted in the Bavarian Medical Graduate Study (N = 570). Exploratory factor analysis indicates a unidimensional scale. Replications of results from previous studies support the scale's content validity: overall, the competence assessment is in the middle range, doctoral graduates rate themselves significantly better than graduates without doctoral degree ($p = 0.047$). Female medical graduates rate themselves worse than male medical graduates ($p = 0.000$). Furthermore, our results suggest that intrinsic motives to do a doctorate mediate the gender effect. According to our analyses, there is a need to progress the research competences of medical graduates as a whole.

1 Background and goal

The quality of research training in medical studies and in medical doctoral studies has been the subject of heated debate in the press and in professional circles for some time now, especially in medical education research (Beisiegel, 2009; Epstein et al., 2016; Horstkotte, 2013; "Ills of the System", 2015). Efforts to improve research training in all phases of medical education, including residency, also relate to the goal of increasing the amount of physician scientists (Epstein et al., 2016; Gerst & Hibbeler, 2012; Senatskommission für klinische Forschung, 2010). Yet, research competences are also important for physicians who primarily work in patient care as these competences enable physicians to practise evidence-based medicine. Whereas this discussion is happening worldwide, in Germany it centers on the unique "Dr. med.", which is usually obtained during medical studies in a shorter period than a Ph.D. Since the doctorate usually represents the only opportunity for an independent research project in medicine, doctoral studies are a central learning context to acquire research competences.

To date, however, few empirical studies exist that examine research competences of medical students and graduates, link it to learning opportunities in the doctoral or postdoctoral stage, or address research careers after graduation. A study by Briedis et al. (2014) shows that doctoral graduates in medicine are 43 percent less likely to remain in academic research in comparison to other STEM fields. Epstein and Fischer (2017) were able to show that doctoral graduates in medicine have lower research-related self-efficacy expectations in comparison to doctoral graduates in other life science disciplines. However, the scale used is not suitable for mapping specific research competences in a differentiated way. Rather, it captures the extent to which respondents are confident in mastering certain challenges of a research career (e.g., "gaining recognition in my scientific community"). The Bavarian Graduate Study in Medicine (MediBAS), class of 2016, used the Freiburg Competency Questionnaire (Giesler et al., 2011), which among other things also encompasses research competences. It shows that also physicians with a doctorate do not always trust themselves to conduct independent research (Epstein et al., 2018). However, some of the questionnaire's items cover rather general analytical skills, and some items encompass multiple competences at once. Thus, the authors conclude that in addition, a more differentiated scale of research competences is needed to assess specific features relevant to the current discussion. In this paper, we introduce the newly developed scale that addresses this need.

2 Methods

As in the cited studies, the newly developed scale measures the respondents' competence level via self-assessments. These have several advantages: they are easy to assess, are highly correlated with external validity criteria for competences and strongly related to behaviour (Braun & Mishra, 2016). We analyse its properties using exploratory factor analysis and multivariate regression analysis. The multivariate analyses serve in particular to test the scale's content validity. Here, gender differences have been shown repeatedly in the past with lower competence assessment by females (Bakken et al., 2003; Epstein & Fischer, 2017). Moreover, a completed doctorate as well as intrinsic motives to pursue the doctorate are associated to higher research competence in medicine (Epstein et al., 2016; 2018). This makes sense since conducting a doctorate leads to more research experience and those with intrinsic motives to pursue a doctorate are probably more devoted to their doctoral project.

2.1 Sample

The Munich Medical Research Competence Scale was piloted within the MediBAS survey, class of 2017. The MediBAS is conducted on a regular basis by the Bavarian State Institute for Higher Education Research and Planning, in cooperation with the "Competence Network Medical Education Bavaria [Kompetenznetz Medizinlehre Bayern]" and its Quality Management and Graduate Survey Working Group. The online survey was directed at all medical graduates from 2017/18 who graduated from the medical faculties of FAU Erlangen-Nuremberg, LMU Munich, TU Munich, University of Regensburg, and JMU Würzburg. The survey was conducted between October 2018 and January 2019 (Reimer et al., 2019). A total response rate of 38 percent (N = 613) was achieved (cf. ibid.). The responses from human medicine (N = 570) were selected for the present study, excluding dentistry and veterinary medicine.

The proportion of female graduates was 66 percent, which is comparable to the nationwide gender distribution in human medicine (approximately 60 percent female; Statistisches Bundesamt, 2019). The majority of graduates were still in the doctoral process at the time of the survey (69 percent, N = 394). 16 percent had already completed their doctorate and 15 percent had not (yet) started. These data are comparable to reported nationwide doctoral rates in medicine (Hachmeister, 2019; Putz, 2011).

2.2 Operationalisation

2.2.1 Development of the Research Competence Scale

We developed the scale of research competences on the basis of the National Competence-based Catalogue of Learning Goals [Nationaler Kompetenzbasierter Lernzielkatalogs, NKLM] (2015), which describes a core set of medical, scientific skills "*as learning goals in medical studies*" (subchapter 14.a, p. 140). When developing the scale's items, we selected competences that covered all phases of empirical research (from determining the state of research to conducting one's own research, items 1–7). Moreover, the items cover the epistemic activities in research, described by Fischer et al. (2014). Those entail basic scientific reasoning processes that are central across discipline, e.g. identifying a problem, generating hypotheses, generating evidence, etc. In addition, the scale encompasses competences of practising evidence-based medicine (EBM) (Items 8–10)). We did not include competences of the NKLM's

subchapter on scientific skills, which were rather related to communicating evidence to patients. While the scale's competences can be assigned to different stages of research, they are also closely linked to one another as well as build on each other. One can argue that these competences can only collectively depict "research competence". This is supported by the conducted analyses (cf. Results, Table 1).

2.2.2 Independent variables

Intrinsic and extrinsic motivation to pursue the doctorate: The motives for taking up a doctorate were measured by a scale developed within the "E-Prom study"[1], encompassing intrinsic motives (e.g., "I wanted to pursue a doctorate in order to conduct research during the doctorate") and extrinsic motives (e.g., "…in order to attain a higher income") (Fischer et al., 2017). The items were very well suited for a factor analysis according to the Kaiser-Meyer-Olkin criterion (kmo = 0.82; Kaiser, 1974) and were analysed by means of explorative factor analysis (principal axis analysis, unrotated, with eigenvalue criterion >1 (Kaiser rule)). As suspected, a two-dimensional structure of intrinsic and extrinsic motives was revealed and supported by a postestimation screeplot and the Minimum-Average-Partial Correlation test (MAP-test) (Velicer, 1976; Velicer et al., 2000; see Appendix, Table A2, Figures A1 and A2). The item relating to the motive of the "customariness" of the doctorate in medicine was excluded due to low factor loading (< 0.5). Presumably, this item represents a separate motive that cannot be strictly classified as extrinsic. While extrinsic motives, such as a higher income, are goal-oriented and involve a weighing of costs and benefits, the present item seems to represent more of an automated choice, a "going with the mainstream" (Kroneberg, 2005). The items of the two subscales were summarised into two separate additive indices ranging from 1 to 5.

Doctorate: For the doctoral status, a distinction was made between the categories 1) "not holding a doctorate" and 2) "holding a doctorate". Persons who were in the process of obtaining a doctorate or discontinued it were excluded, since it remains unclear how advanced these doctorates were. For analyses limited to the group of doctoral graduates, the doctoral grade was summarised into the categories 1) "summa cum laude" 2) "cum laude", 3) lower grades, and 4) no grade (still pending or no grading system).

Sociodemographic background: In addition, we statistically controlled for gender (male vs. female), migration background (yes vs. no), and age of respondents.

[1] The project „Einfluss der Promotionsphase auf die Karriereentwicklung von NachwuchswissenschaftlerInnen in der Medizin und den Lebenswissenschaften" investigated factors influencing postdoc careers in the life sciences.

3 Results

3.1 Factor analysis, Research Competence Scale

The Kaiser-Meyer-Olkin criterion indicated a very good suitability of the items for factor analysis (kmo = 0.93; Kaiser, 1976). The scale was tested by exploratory factor analysis (principal axis analysis, unrotated, with Kaiser rule). The results of the factor analysis (Table 1), a postestimation screeplot and Velicer's MAP-test supported a unidimensional structure (Appendix, Figures A3 and A4). All items achieve satisfactory factor loadings.

Table 1: Exploratory factor analysis: Munich Medical Research Competence Scale[2]

To what extent did you acquire the following knowledge, skills and abilities in your studies?	Factor1
	Factor Loadings
Item 1: Ability to determine the state of research on a research question	0.64
Item 2: Ability to present the knowledge gained through an empirical study	0.75
Item 3: Ability to critically discuss the validity of a scientific investigation with regard to methodological aspects	0.80
Item 4: Ability to interpret the result of a statistical hypothesis test	0.78
Item 5: Ability to derive testable hypotheses based on the research question	0.82
Item 6: Ability to name possible research methods (e.g. from basic medical research, clinical or epidemiological research) and to justify them	0.81
Item 7: Ability to implement research ideas methodically and technically correctly	0.78
Item 8: Ability to derive concrete actions or therapeutic options from empirical evidence	0.79
Item 9: Ability to evaluate study results in terms of applicability to a patient case	0.79
Item 10: Ability to classify studies into evidence classes	0.64

Legend: *N* = 570, Question: (Scale: 1 = not at all to 5 = to a very high degree).

3.2 Descriptive results

Table 2 shows the descriptive results, mean values with standard deviations, of the self-assessed research and EBM competences – overall, as well as differentiated by gender and completed doctoral degree.

[2]The English items were translated by the authors for this publication only. The original German items are in the Appendix (Table A1).

Table 2: Self-assessed research competences, Munich Medical Research Competence Scale

	Overall		Female		Male			Dr.med.		No Dr.med.		
	M	*SD*	*M*	*SD*	*M*	*SD*	*p*	*M*	*SD*	*M*	*SD*	*p*
Item 1: determine state of research	3.42	1.05	3.36	1.04	3.55	1.05	0.052	3.62	1.00	3.38	1.06	0.029
Item 2: present knowledge from empirical study	2.86	1.04	2.79	1.04	3.01	1.01	0.020	2.92	1.04	2.84	1.04	0.474
Item 3: critically discuss a study's methodology	2.79	1.00	2.67	0.97	3.04	1.03	0.001	2.95	0.98	2.76	1.01	0.069
Item 4: interpret statistical test results	2.68	0.99	2.59	0.92	2.88	1.07	0.001	2.87	0.94	2.65	0.99	0.044
Item 5: derive testable hypotheses	2.50	0.97	2.41	0.90	2.72	1.05	0.000	2.66	0.99	2.48	0.96	0.103
Item 6: name possible research methods	2.57	0.95	2.43	0.87	2.83	1.04	0.000	2.78	0.95	2.53	0.95	0.014
Item 7: implement research ideas correctly	2.25	1.03	2.09	0.96	2.53	1.12	0.000	2.55	1.08	2.19	1.02	0.001
Item 8: derive therapeutic options from evidence	2.74	1.04	2.62	1.01	2.97	1.07	0.000	2.88	1.04	2.71	1.04	0.122
Item 9: evaluate studies' applicability to cases	2.74	1.03	2.63	1.01	2.92	1.04	0.002	2.83	1.03	2.72	1.03	0.327
Item 10: sort studies in evidence classes	2.77	1.13	2.62	1.06	3.04	1.18	0.000	2.78	1.15	2.77	1.12	0.794
N	**570**		**362**		**190**			**92**		**478**		

Legend: Means *(M)* and standard deviations *(SD)* rounded to the second decimal place, p-values rounded to the third decimal place and determined using two-tailed t-tests.

In relation to the scale midpoint, the surveyed physicians rated themselves as rather average overall. The competence of determining the state of research to a research question received the highest rating. The competences of presenting the knowledge gained from a study and evaluating the significance of a scientific study were rated lower. Activities that are more specific and require more methodological/statistical knowledge, such as interpreting the results of a hypothesis test, deriving hypotheses and selecting a research method, were rated even lower. The competence of implementing a research idea in a methodologically and technically correct manner received the lowest ratings, with the mean value below the scale midpoint. Respondents' self-ratings regarding EBM (deriving therapy options, evaluating applicability to the patient, and sorting studies into evidence classes) were in the middle range, too.

In terms of gender, it is noticeable that female graduates rated themselves slightly lower than male graduates. The differences in mean scores are small but significant and are evident across almost all items, with the exception of determining the state of research to a specific research question. Furthermore, we analysed gender differences regarding intrinsic and extrinsic motives for taking up a doctorate by means of two-sided t-tests. We found small but significant gender differences here: Women agreed less with intrinsic (M = 2.82 (SD = 1.10) vs. M = 3.10 (SD = 1.15), p = 0.006) *as well as* extrinsic motives (M = 2.94 (SD = 0.99) vs. M = 3.21 (SD = 0.90), p = 0.002).

The comparison of graduates with and without doctoral degree shows that doctoral graduates only rate themselves significantly better with regard to the competences of determining the state of research, interpreting the result of a hypothesis test, selecting a research method, and implementing a research method in a technically and methodologically correct manner. The mean differences are small, so that the self-assessed competences of doctoral graduates as a whole remain in the middle range. With regard to the items relating to evidence-based medicine, doctoral and non-doctoral graduates rate their competences comparably.

3.3 Multivariate results

In the following, we present results of multivariate regression analyses. First, we analyse the association among gender, age, migration background, completed doctorate and self-assessed competence level. Second, we include the doctoral grade as well as the information on the motivation for taking up the doctorate for the subgroup of doctoral graduates.

3.3.1 All survey participants

When considering all survey participants (see Table 3), the gender variable shows the biggest effect size. On average, women rate themselves –0.3 points lower on the overall scale of research competences. In addition to gender, only doctoral status is significantly related to self-assessed competences: Doctoral graduates, on average, rate themselves 0.19 points better. Neither age nor migration background show significant effects on the assessment of research competences.

Table 3: Multivariate regression analysis, dependent variable: Munich Medical Research Competence Scale (All survey participants)

	β	*SD*	*p*
Completed doctorate *(Reference: no completed doctorate)*	0.19	0.10	0.047
Female *(Reference: Male)*	–0.30	0.07	0.000
Age	0.00	0.01	0.683
Migration background *(Reference: None)*	–0.10	0.09	0.254
Constant	2.96	0.35	0.000
N	512		
Adj. R^2	0.04		

Legend: Multivariate regression analysis with dependent variable scientific competences, ß-coefficients and standard deviations (*SD*) rounded to the second decimal place, p-values rounded to the third decimal place.

3.3.2 Doctoral graduates

Looking only at doctoral graduates in Table 4, females assess their competences lower than men (Model 1), even when controlling for dissertation grade. In Model 2, we introduce the variables intrinsic and extrinsic motives for the doctorate. Intrinsic motives are positively and significantly associated with self-assessed competences, whereas there is no association with extrinsic motives. Moreover, the gender effect is no longer significant after the introduction of motives: Apparently, male and female doctoral graduates with equally pronounced motives for starting the doctorate do not differ with respect to self-assessed research competences.

Table 4: Multivariate regression analysis, dependent variable: Munich Medical Research Competence Scale (Doctoral graduates)

	Model 1			Model 2		
	β	*SD*	*p*	*β*	*SD*	*p*
Grade: Summa/Magna cum *(Reference: lower grade)*	0.47	0.18	0.009	0.30	0.18	0.093
Female *(Reference: Male)*	–0.39	0.18	0.033	–0.29	0.18	0.108
Age	0.02	0.29	0.942	–0.02	0.04	0.638
Migration background *(Reference: None)*	–0.06	0.04	0.210	0.17	0.29	0.561
Intrinsic motives				0.26	0.08	0.001
Extrinsic motives				0.05	0.09	0.589
Constant	4.78	1.46	0.002	2.15	1.52	0.162
N	77			77		
Adj. R^2	0.11			0.20		

Legend: Multivariate regression analysis with dependent variable scientific competences, ß-coefficients and standard deviations (*SD*) rounded to the second decimal place, p-values rounded to the third decimal place.

4 Summary and discussion

The aim of the present article was the analysis of research competences among medical graduates with the newly developed Munich Medical Research Competences Scale that was piloted at the medical faculties in Bavaria. The results of the exploratory factor analysis with postestimation screeplot and MAP-test supported a unidimensional scale. The replication of previous research results supports the content validity of the scale but also allow a more differentiated look on specific competences among medical graduates with and without doctoral degree.

Our results illustrate that research competences in medical graduates are in need of development, especially in the areas of study design, implementation, and interpretation. These competences, such as critically interpreting study results considering all aspects of the study – design, implementation and statistical analyses – do not only build the basis to become an independent researcher, but are also crucial for practising evidence-based medicine.

Doctoral graduates and male physicians assess their competences only slightly higher in comparison to those without completed doctorates and females. The small difference between those with and without a doctorate, among other reasons, might result from the level of independence during the doctorate. Since the doctorate in medicine, other than in any other discipline, is usually mainly pursued during undergraduate studies, there is less prior experience (e.g., through bachelor's and master's theses) and a lower degree of independence is a plausible assumption. However, no (comparative) analyses are available in this regard. The role of independence of doctoral research should be analysed in the future, ideally by comparing multiple disciplines.

The scales' items addressing competences in the area of EBM also indicate room for development. However, the question arises as to how these competences develop in the context of further professional experience. Analyses referring to those with completed doctorate show that the lower competence assessment of female doctoral graduates persists even under statistical control of the doctoral grade. This result is consistent with previous findings showing that female medical doctoral graduates indicate significantly lower research self-efficacy beliefs, even when including more achievement parameters, such as doctoral grades and publications (Epstein & Fischer, 2017). However, in the present study – in contrast to the cited one – the gender effect on competence assessment is no longer significant when controlling for doctoral motives: Intrinsic motives, which are less pronounced among females and significantly related to research competences, entirely explain the gender effect here. This warrants the assumption that those who begin the doctorate in order to gain research experience and possibly to continue to research after graduation, are presumably more eager

to acquire competences during the doctoral phase and possibly go beyond the mere requirements of the doctorate. Intrinsically motivated individuals may also choose a more scientifically demanding and better supervised doctoral project from the outset. Thus, grades and publications may not be sufficient to capture acquired competences. This could be one reason why these "objective" indicators cannot explain the gender effect.

Our analyses are based on cross-sectional data. Using the scale at different points in time from the beginning to the end of the study programme could reveal in which phases competence acquisition takes place and in which phases it stagnates. On this basis, targeted adjustments could be made to the curriculum. With regard to the recurring findings on gender differences in medicine – considering research self-efficacy and competences (Bakken et al., 2003; Epstein & Fischer, 2017) but also publications output (Pfeiffer et al., 2016) – complementary qualitative studies could help to understand this phenomenon. Due to the method of self-assessment, actual competences may differ between males and females. Furthermore, our results refer to five faculties in Bavaria; despite the broad data basis, the results may be different depending on the context, for example if research skills are trained more effectively in reformed medical programmes.

Conflicts of interest

The authors report no conflicts of interest.

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References

Bakken, L.L., Sheridan, J., & Carnes, M. (2003). Gender differences among physician–scientists in self-assessed abilities to perform clinical research. *Academic Medicine, 78*(12), 1281–1286.

Beisiegel, U. (2009). Motivation des Nachwuchses für die medizinische Forschung. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 52*(8), 850-855.

Braun, E., & Mishra, S. (2016). Methods for Assessing Competences in Higher Education: A Comparative Review. In J. Huisman & M. Tight (Eds.), *Theory and Method in Higher Education Research* (Vol. 2, pp. 47-68). Emerald Group Publishing Limited. https://doi.org/10.1108/S2056-375220160000002003

Briedis, K., Jaksztat, S., Preßler, N., Schürmann, R., & Schwarzer, A. (2014). *Berufswunsch Wissenschaft. Laufbahnentscheidungen für oder gegen eine wissenschaftliche Karriere* (Forum Hochschule 8/2014). DZHW.

Epstein, N., Huber, J., Gartmeier, M., Berberat, P.O., Reimer, M., & Fischer, M. R . (2018). Investigation on the acquisition of scientific competences during medical studies and the medical doctoral thesis. *GMS Journal for Medical Education, 35*(2), Doc20.

Epstein, N., & Fischer, M.R. (2017). Academic career intentions in the life sciences: Can research self-efficacy beliefs explain low numbers of aspiring physician and female scientists? *PloS one, 12*(9), e0184543.

Epstein, N., Pfeiffer, M., Eberle, J., von Kotzebue, L., Martius, T., Lachmann, D., … Fischer, M.R. (2016). Nachwuchsmangel in der medizinischen Forschung. Wie kann der ärztliche Forschernachwuchs besser gefördert werden? *Beiträge zur Hochschulforschung, 38*(1-2), 162–189.

Fischer, M.R., Herzig, S., Neuhaus, B.J., Prenzel, M., & Berberat, P.O. (2017). Einfluss der Promotionsphase auf die Karriereentwicklung von NachwuchswissenschaftlerInnen in der Medizin und den Lebenswissenschaften, Kohorte 1 (E-Prom). *GESIS Datenarchiv, Köln. ZA6762 Datenfile Version 1.0.0.* https://doi.org/10.4232/1.12713

Fischer, F., Kollar, I., Ufer, S., Sodian, B., Hussmann, H., Pekrun, R., ... Eberle, J. (2014). Scientific reasoning and argumentation: advancing an interdisciplinary research agenda in education. *Frontline Learning Research, 2*(3), 28-45.

Gerst, T., & Hibbeler, B. (2012). Klinische Forschung: Ärztemangel im Labor. *Deutsches Ärzteblatt, 109*(37), 1804.

Giesler, M., Boeker, M., Fabry, G., & Biller, S. (2016). Importance and benefits of the doctoral thesis for medical graduates. *GMS J Med Educ. 33*(1), Doc8.

Hachmeister, C.-D. (2019). Im Blickpunkt: Promotionen als Indikator für die Leistung von Hochschulen. Auswertung von Daten des Statistischen Bundesamtes und des CHE Rankings 2019/20. *CHE Working Paper.* Retrieved on 05.11.2020 from https://www.che.de/wpcontent/uploads/upload/Im_Blickpunkt_Promotionen_2019.pdf.

Horstkotte, H. (2013). Wie gut sind Mediziner-Promotionen? *Zeit Online.* Retrieved from: https://www.zeit.de/studium/hochschule/2013-10/doktorarbeiten-promotionen-wissenschaft-mediziner.

Ills of the System. Reform is long overdue for Germany's archaic medical-education system, which puts undue pressure on students and contaminates the scientific literature. (2015). *Nature*, *527*, 7. doi: 10.1038/527007a.

Kaiser, H.F. (1974). An index of factorial simplicity. *Psychometrika, 39*(1), 31-36.

Kroneberg, C. (2005). Die Definition der Situation und die variable Rationalität der Akteure/The Definition of the Situation and the Variable Rationality of Actors: Ein allgemeines Modell des Handelns/A General Model of Action. *Zeitschrift für Soziologie, 34*(5), 344-363.

Nationaler Kompetenzbasierter Lernzielkatalog (NKLM). (2015). *MFT Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V.* Retrieved 02/2021 from http://www.nklm.de/kataloge/nklm/lernziel/uebersicht.

Pfeiffer, M., Fischer, M.R., & Bauer, D. (2016). Publication activities of German junior researchers in academic medicine: which factors impact impact factors? *BMC Medical Education, 16*(1), 190.

Putz, R.M. (2011). Medizinstudium. Promotion. Habilitation in Deutschland. In D. Bitter-Suermann (Ed.), *Wissenschaftliche Medizinerausbildung – 100 Jahre nach Flexner. Tagung des Medizinischen Fakultätentages und des Wissenschaftskollegs zu Berlin* (pp. 51-56). Berlin: Medizinischer Fakultätentag der Bundesrepublik Deutschland.

Reimer, M., Kopecny, S., & Pünder, T. (2019). *Bayerische Humanmediziner Jahrgang 2017: Rückblick aufs Studium, Weiterbildung und Berufsübergang. Ergebnisbericht der MediBAS in Bayern für die Humanmedizin*. Bayerisches Staatsinstitut für Hochschulforschung und Hochschulplanung.

Senatskommission für Klinische Forschung. (2010). *Empfehlungen der Senatskommission für Klinische Forschung. Strukturierung der wissenschaftlichen Ausbildung für Medizinerinnen und Mediziner*. Deutsche Forschungsgemeinschaft (DFG).

Statistisches Bundesamt. (2019). *Bildung und Kultur, Prüfungen an Hochschulen 2018*. (Fachserie 11, Reihe 4.2).

Velicer, W.F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika, 41*(3), 321-327.

Velicer, W.F., Eaton, C.A., & Fava, J.L. (2000). Construct Explication through Factor or Component Analysis: A Review and Evaluation of Alternative Procedures for Determining the Number of Factors or Components. In R.D. Goffin & E. Helmes (Eds.), *Problems and Solutions in Human Assessment* (pp. 41-71): Springer. https://doi.org/10.1007/978-1-4615-4397-8_3

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Appendix

Table A1: Münchner Skala zu Forschungskompetenzen in der Medizin

Frage: In welchem Maße haben Sie die folgenden Kenntnisse, Fähigkeiten und Fertigkeiten in Ihrem Studium erworben? (Skala: 1 = gar nicht bis 5 = in sehr hohem Maße)
Item 1: Fähigkeit, den bisherigen Kenntnisstand zu einer Fragestellung zu recherchieren
Item 2: Fähigkeit, den durch eine Untersuchung erreichten Erkenntnisgewinn darzustellen
Item 3: Fähigkeit, die Aussagekraft einer wissenschaftlichen Untersuchung hinsichtlich methodischer Gesichtspunkte kritisch zu diskutieren
Item 4: Fähigkeit, das Ergebnis einer statistischen Hypothesenprüfung zu interpretieren
Item 5: Fähigkeit, von der Forschungsfrage ausgehend, testbare Hypothesen herzuleiten
Item 6: Fähigkeit, mögliche Untersuchungsmethoden (z. B. aus der medizinischen Grundlagenforschung, der klinischen oder epidemiologischen Forschung) zu benennen und wissenschaftlich zu begründen
Item 7: Fähigkeit, Forschungsideen methodisch und technisch korrekt umzusetzen
Item 8: Fähigkeit, konkrete Handlungen bzw. Therapiemöglichkeiten aus der empirischen Evidenz abzuleiten
Item 9: Fähigkeit, Studienergebnisse in Bezug auf die Anwendbarkeit auf einen Patientenfall zu bewerten
Item 10: Fähigkeit, Studien in Evidenzklassen einzusortieren

Table A2: Scale of intrinsic and extrinsic motives, results of exploratory factor analysis

I wanted to do a doctorate ...	**Factor 1**	**Factor 2**
	intrinsic	**extrinsic**
(since the doctorate is largely common in my subject)	(–0.069)	(0.395)
since I feared disadvantages on the job market without a doctorate	0.137	0.555
to be able to work in research after the doctorate	0.794	0.009
to develop my professional competences	0.803	–0.086
to research during the doctorate	0.873	–0.098
to be able to work more intensively on the specific topic of my doctorate	0.732	–0.094
to keep the possibility of a research career open	0.733	0.100
to be better able to practise and understand EBM	0.610	–0.018
to earn a higher income than without a doctoral degree	0.167	0.503
for a higher societal reputation	0.002	0.744
to be perceived by patients as a competent physician	–0.092	0.746
to have a higher reputation among colleagues	0.119	0.744

Legend: N = 570. (scale: 1 = not at all true to 5 = completely true). Factor loadings rounded to the third decimal place.
Principal axis analysis, unrotated. Excluded item in parentheses.

Figure A1: Postestimation Screeplot, intrinsic and extrinsic motives

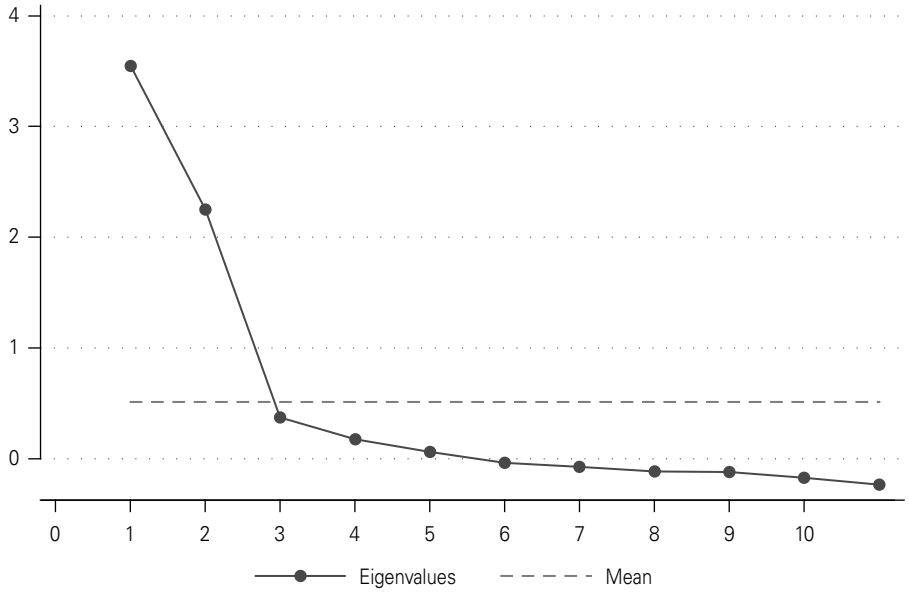

Figure A2: MAP-Test, intrinsic and extrinsic motives

Minimum Average Partial Correlation for Number of Principal Components

NOTE: Pick number of components (m) at which fm is minimum.
If f1 > f0 (average intervariable correlation)
then no components should be extracted.

m = 0 f 0 = .13469679

m = 1 f 1 = .06969177
m = 2 f 2 = .0406374
m = 3 f 3 = .05284884
m = 4 f 4 = .06925403
m = 5 f 5 = .10751293
m = 6 f 6 = .13994796
m = 7 f 7 = .20594091
m = 8 f 8 = .31526583
m = 9 f 9 = .56000138
m = 10 f10 = 1

minap procedure suggests that 2 principal components should be extracted.

For comparison, the Kaiser eigenvalue > 1 rule suggests extracting 2 principal components.

Figure A3: Postestimation Screeplot, Munich Medical Research Competences Scale

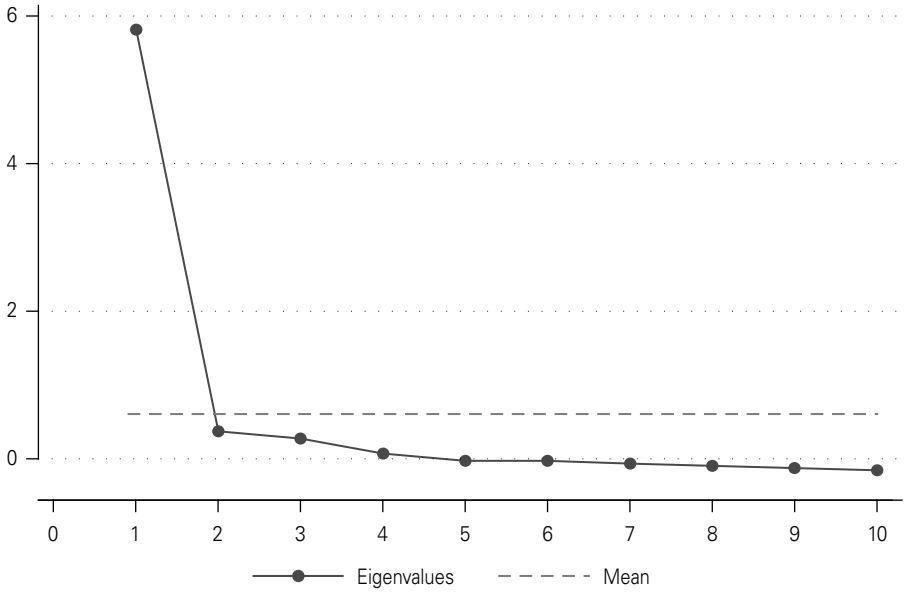

Figure A4: MAP-Test, Munich Medical Research Competences Scale

Minimum Average Partial Correlation for Number of Principal Components

NOTE: Pick number of components (m) at which fm is minimum.
If f1 > f0 (average intervariable correlation)
then no components should be extracted.

m = 0 f0 = .33736399

m = 1 f1 = .03093972
m = 2 f2 = .04512596
m = 3 f3 = .06018905
m = 4 f4 = .09967063
m = 5 f5 = .13665191
m = 6 f6 = .19713592
m = 7 f7 = .27515224
m = 8 f8 = .44932073
m = 9 f9 = 1

minap procedure suggests that 1 principal component should be extracted.

For comparison, the Kaiser eigenvalue > 1 rule suggests extracting 1 principal =component.

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Initiating interprofessional learning in health professions – the OSCE as a teaching-learning format

Marie-Luise Junghahn, Doreen Herinek, Jana Rückmann

Regarding safe and patient-oriented health care, interprofessional teaching, learning and work become increasingly important. Hence, health professionals must be enabled to act cooperatively (Robert Bosch Stiftung, 2011). Educational programmes in academic and non-academic, initial and continuing education and training in the health professions face criticism of the lack of interprofessional education to prepare for interprofessional collaborative practice (Wesselborg, 2017). This article investigates to what extent the competence-oriented examination format OSCE (Objective Structured Clinical Examination), here as a further developed teaching-learning format, is suitable for initiating interprofessional learning of future health professions educators. A qualitative survey was carried out to examine students' subjective views on the use of an OSCE format in higher education and contained eight semi-structured interviews. The results indicate that the OSCE as a teaching-learning format offers multiple opportunities for initiating interprofessional learning.

1 Introduction

Developments in health care systems are characterised by treatment and care scenarios that are becoming increasingly complex and multidimensional. So there is a need for professional differentiation, specialisation and associated division of labour (Kälble, 2019) in order to be able to act professionally in these fields. Scopes of practice for health professionals are progressively broader, from previously narrower fields of professional activity. Consequently, the requirements for cooperative, collaborative and closely coordinated action by academic and non-academic qualified health professions involved in the care process are increased. This illustrates the relevance of interprofessional collaboration in the health care system. Recommendations demand to promote interprofessionality within the framework of vocational academic and non-academic training of health professions (GMK & KMK, 2015; WR, 2012). This article refers to the German context of health professions education, where the majority of health professions (except physicians) are trained in non-academic vocational schools.

Designing teaching in such a way that health professional students and trainees focus on interprofessional collaboration poses challenges for educators in both academic and non-academic training institutions. Consequently, it is necessary to prepare future

health professions educators (HPEs) for the design of interprofessional teaching-learning arrangements. However, little is known about how to approach interprofessional education (IPE) during the qualification phase of their studies (Walkenhorst et al., 2015). In contrast to traditional academic education of health professions in Germany (e.g. physicians), the anchoring and strengthening of interprofessionality for non-traditionally academically trained health professions[1] is cautiously apparent (Jünger, 2019). This paper focuses on the question how future HPEs[2] for vocational schools can be prepared for interprofessional teaching within the framework of the Master's programme "Health Professions Education" at the Charité – Universitätsmedizin Berlin.

2 Interprofessional education in academic and non-academic educational processes

The internationally recognised concept of interprofessional education (IPE) is becoming increasingly relevant for the conceptual design of educational programmes in the health care sector (Ewers & Walkenhorst, 2019; Hammick et al., 2007; Reeves et al., 2017). IPE takes place "*[...] when two or more professions learn with, from and about each other to improve collaboration and the quality of care*" (CAIPE, 2002, p. 6).

In addition to various stipulations that anchor IPE in medical education (e.g. *Master Plan for Medical Studies 2020*), efforts to include IPE into professional laws and training and examination regulations are also discernible for other health professions. The respective training institutions are responsible for offering interprofessional teaching and learning arrangements. However, in Germany, corresponding educational concepts and the design of innovative teaching-learning units are still in their infancy (Kälble, 2019).

Within the framework of the "Operation Team – Interprofessional education in Health Professions" programme of the Robert Bosch Foundation (Robert Bosch Stiftung, 2018), various interprofessional settings were explored. It demonstrated that developing and implementing interprofessional learning is linked to a number of complex interrelated prerequisites: joint planning of courses, interdisciplinary knowledge, professional expertise, social competences to cooperate, professional views and working methods of the actors involved (Nock, 2016).

[1] In Germany, 16 health professions are primarily trained on a three-year basis at vocational schools. Those with the most training places on average each year are those in nursing, physiotherapy, occupational therapy, pharmaceutical-technical assistance and rescue assistance.

[2] In contrast to teachers for vocational schools, medical teachers only receive further training in university didactics in medical faculties.

Qualification of academic and non-academic HPEs

The findings of the programme "Operation Team" illustrate diverse challenges of interprofessional learning opportunities. They give indication of how important it is to raise awareness of HPEs in academic and non-academic settings towards IPE. In particular, it is stated that preparation is needed to teach IPE (Botma, 2019).

As a possible approach for giving impetus to the training of future teachers, existing findings on the design of interprofessional learning in health professional training can serve. Sieger et al. (2010) see possibilities to stimulate interprofessional discourses by intergrating health professionals into a common framework of thinking and acting. In this way, it is possible to reflect on the respective areas of responsibility and patterns of competence, to make demarcations and overlaps of tasks, and to establish collaborative teamwork. To ensure that such interprofessional exchanges do not remain merely an addition of specialist knowledge, it is recommended that those involved should work together on issues. Therefore, Sottas et al. (2016) advise that this is best done by taking into account one's own point of view as well as those of the others, in order to be able to work out practicable solutions together. To implement such scenarios, interactive learning methods, for example, enabling students to get to know each other so that they can learn from and about each other should be chosen (Mackay, 2002).

3 Develop action-related competences in interprofessional contexts

This article focuses on future HPEs studying the four-semester Master's programme in Health Professions Education at the Charité – Universitätsmedizin Berlin. The programme qualifies for a career as educator in vocational schools or universities of diverse health professions. From their first semester on, students will find themselves in an interprofessional group (nurses, physiotherapists, occupational therapists, speech and language therapists and midwives).

In the winter semester 2018/19, a project with 36 students was carried out from 01.01.2019 to 31.01.2019 as part of the module "Assessment and Evaluation". The module aimed to sensitise future HPEs to the subject of interprofessional examinations and also towards interprofessional collaboration. In the project, interprofessional collaboration meant a social process in which people from different professional groups work together to find solutions to a complex practical problem that they could not have solved satisfactorily individually (Schroeder, 2010). This aims to create a common context for thinking and acting, and exposes the future HPEs to work on a complex task – the collaborative design and management of a complex examination situation.

3.1 Developing action competence

In this context, the Health Professions Education programme faces the challenge of developing teaching-learning formats that aim to convey an action-related understanding of competence in an interprofessional context. This action-related understanding of competence follows the vocational and business education tradition (e.g. Achtenhagen, 2004; Reetz, 1990). Roth (1971) and Achtenhagen (2004) take up differentiation into professional, personal and social competence in their competence performance model to clarify the connection between competence, development and performance. They assume that partial competences organise themselves in a self-regulating way in a specific context and a concrete situation of requirements which then manifest themselves in a concrete action, i.e. performance. Students need concrete task requirements in an interprofessional action context to develop and demonstrate an action-related understanding of competence for interprofessional collaboration. We selected the OSCE (Objective Structured Clinical Examination) as context for action. Against the background of competence-oriented training and examination regulations in health professions education, the OSCE is increasingly being tested as a competence-oriented examination format in Germany (Handgraaf et al., 2004; Wissing et al., 2017).

3.2 The OSCE as a teaching-learning format

The OSCE, which was originally developed for medical education (Harden et al., 1975), serves to test clinical-practical skills in a structured manner. Various clinical situations are simulated under standardised conditions at several stations or tasks are worked on in writing. Trained examiners evaluate performance using a pre-defined checklist or global assessment worksheet. The advantage of the OSCE is to achieve high objectivity and better comparability due to the controlled conditions (Nikendei & Jünger, 2006).

The OSCE was designed and used as teaching-learning format in the didactic implementation of the module project. The students were asked to create a task in small groups on a concrete action situation from professional practice which was to be completed in the course of the examination. This created the prerequisite for the students to be able to agree on the respective professional actions of those involved. In this context, the OSCE did not primarily serve to test students' competences. Moreover, the idea was to provide space for interaction and exchange within the framework of a joint planning and testing phase of an OSCE station. Here, they were able to reflect on individual experiences in an interprofessional setting and develop openness towards the professional fields of action of the other participants with different professional background.

3.3 Implementation of the module project

First, the future HPEs were introduced to the OSCE from a theoretical perspective. They met independently in small groups composed of different professions and decided on the subject area for designing an OSCE station together. They looked for a suitable action situation for the examination, formulated questions and tasks and wrote a role description as well as instructions for the simulation patient. In a further step, group members drew up a checklist with corresponding suggested solutions for the assessment; then compiled informations on the required material and room design (Schlegel, 2018). During simulation of the examination situation, the students acted in various roles: examiner, examinee and simulation patient. They also had to prepare for the roles of examiner and simulation patient in run-up to the exam. Afterwards, the future HPEs evaluated each other's conceptions and testing of the OSCE from an observer's or an examinee's perspective using an independently developed evaluation instrument. Finally, the students gathered the data they had obtained, discussed challenges and opportunities in their working group and presented their results in a plenary session.

4 Studies on the module project

With the aim of improving teaching in the Masters in HPE, the module project was investigated empirically and reflected upon in accordance with Scholarship of Teaching and Learning (SoTL), a scientific approach to their teaching and student learning in institutional environment as field of research (Pawelleck et al., 2020). The study aimed to find out to what extent students perceive the methodological approach of OSCE as teaching-learning format to be a suitable framework for thinking and acting (Sieger et. al., 2010) to stimulate interprofessional discourses between them. An explorative qualitative interview study was chosen to allow students to reflect and share their experiences from the project in the spirit of the reflective practitioner (Schön, 1983).

4.1 Research questions

The research questions focus on the experiences of students during the OSCE module project and which thoughts and reflective processes were initiated in this interprofessional setting. It also inquires what contribution the project can ultimately make to raising awareness of interprofessional collaboration between the health professionals involved.

4.2 Methodological approach

The methodological starting point of this study is an interpretative paradigm (Keller, 2012) which understands *"social reality as a reality constituted by acts of interpretation"*

(Lamnek & Krell, 2016, p. 46). In this sense, the focus is on description, recording and interpretation of experienced simulated reality in the context of the processes of developing and implementing OSCE stations. The qualitative interview study provides a differentiated description of students' subjective views and attitudes (Flick et al., 2015). This generates the widest possible range of aspects, which is considered significant with regard to the research objective. The data collection took the form of guideline-based focused individual interviews (Merton & Kendall, 1979). In order to be able to open up the subject matter, which has been little researched to date, the guiding questions were developed according to the principle of openness (Kruse, 2015) using the "SPSS method" (collect, test, sort, subsume) proposed by Helfferich (2011)[3].

The interviewees were selected by means of intentional, deductive sampling. The survey included students in the third semester of the "Health Professions Education" programme who had participated in the project over the entire period without absences. Recruitment was based on a convenience sample (Dörnyei, 2007) for participation in the study. The interviewees were three nurses, two occupational therapists, one physiotherapist, one speech therapist and one midwife. All of them had worked in their profession for at least two years before they decided to return to study. The interviewees were between 25 and 41 years old. The total individual interviews (N = 8) were conducted after the end of lecture period between March 2019 and May 2019. The interviews took between 27 and 44 minutes. The key questions focused on descriptions of concrete experiences in the OSCE module project, of different roles they took on in the process and the perception of teamwork.

The interviews were digitally audio-recorded and transcribed verbatim (Dresing & Pehl, 2015). The analysis was based on the method of Circular Deconstruction (Jaeggi, Faas, & Mruck, 1998). The two-stage analysis is characterised by its open access to empirically based categories which are derived from data material. The term Circular Deconstruction is derived from the procedure of text analysis. The results of individual work steps were continuously fed back and cross-checked with the source material. They revealed interview-specific differences and similarities with regard to the central categories. These were organised further into main and sub-categories and paraphrased comparatively (ibid.).

5 Subjective views of the students

The results refer to the simulated development and implementation of the OSCE stations. The three main categories are (1) joint development of OSCE examination

[3]The study deemed exempt from ethical review under local legislation, because it does not involve patients or vulnerable groups. Due to the shortage of time, no piloting was done.

stations, (2) simulation of examination situations and (3) joint learning. They are presented and partly characterised by the respective sub-categories.

5.1 Jointly developing OSCE stations

When planning the OSCE station, it was considered that the examination station to be developed should be run by the fellow students of the other working groups themselves. The students aimed to find a topic that all professional groups could relate to, successfully complete the examination task and benefit from it. According to the interviewees, the topic selection for the OSCE station took place in an intensive exchange process. During this process, common features of the individual professional fields of action were discussed:

"What has everyone been in contact with? And then we first came across skin and then somehow wounds [...]. It somehow came about because we wanted to have something where our professions had a lot in common. And midwives also have to deal with wounds, if you think of a caesarean section or something like that, they also have to take care of them." (Interview 4, L 302-307).

5.2 Simulating examination situations

During simulation of the OSCE, students took on different roles in which they encountered uncertainties. In their view, their own assessment of their professional competence played a significant role. Their perceived uncertainty would also have led them to want to take on a more *neutral* role in their subject. Uncertainties also arose for the examiner if, in the simulated exam situation, the examinee was unable to fulfil requirements of the exam due to having a different occupation and thus lack of specific knowledge. The examiners would have tended to help:

"And it was really hard for me in the examining role to endure this helplessness and not to get the impulse to slip out of this pure examining role and to give support, because it is no longer comparable." (Interview 8, L 264-271).

It also became clear that respondents approached the respective roles openly and curiously about the *unknown* situation:

"I also found it great that we ourselves [...] were tested in the OSCE. I was in a situation where I was an occupational therapist in care group and wanted me to measure someone's blood pressure, pulse and honestly, you don't learn this in occupational therapy and I've never done it before and it was very exciting experience and to go

there and think: "I'm trying my best now, but I have no idea what I'm actually doing here."" (Interview 5, L 107-115).

5.3 Shaping joint learning

According to the interviewees, the development of an OSCE station resulted in a variety of exchange processes. Concrete information about the respective other professional field of action was produced and perceived as a gain in knowledge.

In addition, different professional perspectives could be adopted in the situations in which they informed each other:

"You look at it from so many different angles, so to speak, says one example: Where do you put the little table that you have next to the nursing bed. Where does it stand when a patient is virtually paralysed on one side? For the physiotherapist, of course, this means that he has to move as much as possible. The nurse might think, well, if it's a fresh apoplexy, it's also quite good if the table is positioned in such a way that the patient with a healthy hand can always grab it quickly, because you're already thinking, oh God, I don't have time to always go to doorbell and at the beginning it's also important that the patient can have a drink, can take something. That you can already see, different points of view simply come together, which all have their justification to look, how do you make something out of it; but also not to forget the patient, which might also bring in occupational therapy." (Interview 7, L 294-309).

Learning opportunities would have arisen not only in the planning process but also in the context of the simulated implementation of individual OSCE stations. For example, following the simulation of an examination situation, a joint exchange about the respective field of action of the other had developed:

"And then one of the nurses explained this to us in detail, [...] to me and the other occupational therapist. And that was totally exciting. It was also very interesting and a total win." (Interview 5, L 372-376).

The respondents perceived the joint handling of developing an OSCE station, testing it and reflecting on the process as a joint process within the team. The mutual support that the interviewees experienced in various situations is personally enriching for them:

"Together with the physiotherapist, we were able to support each other quite well, because somehow, I knew exactly what the sitting position was, what to do with the arm and she was more like holding the knee and so on. And then we could enrich each other." (Interview 5, L 393-397).

6 Summary and discussion

The findings provide an insight into subjective views of future HPEs from the Master's programme of the same name, on a module project in which the OSCE was used as a teaching-learning format. The results provide information on the extent to which the OSCE in this format can contribute to preparing future HPEs for interprofessional collaboration and interprofessional teaching. However, the extent to which interprofessional teaching leads to improved interprofessional collaboration and thus to increased quality of care and patient safety has not yet been sufficiently clarified and needs to be further researched.

The joint development and testing of an OSCE station has sparked a variety of processes among students. The concrete reference to specific cases has created an opportunity to exchange information about individual professional actions of the professional groups involved. Furthermore, the students showed an interest and openness in getting to know other professional fields and situations of the respective group members and wanted to gain more knowledge about them. Thus, the teaching-learning format OSCE as a common framework for thinking and acting (Sieger et al., 2010) can contribute to promote to learn from and about each other (Mackay, 2002) and thus the appreciation of the different occupational groups as well as the mutual understanding for and of each other. With reference to the competence performance model (Achtenhagen, 2004), the OSCE as teaching-learning format seems to initiate personal and social competence development in particular through increased communication between the participants.

The need for appropriate preparation and qualification of teachers for interprofessional teaching is undisputed (Nock, 2016; Walkenhorst et al., 2015). Due to various challenges in the long-term implementation of interprofessional teaching-learning arrangements (Nock, 2016), the guiding idea here is to transform existing formats and make them adaptable for interprofessional education.

During the future implementation of the OSCE as teaching-learning format, more attention should be paid to the fact that the interprofessional processes – at least, the findings of our study suggest – often only occur implicitly among students and therefore require intensive reflection (HRK, 2017). Within the framework of the course, phases of group communication are needed in which individual experiences with the topic interprofessionality can be agreed. The integration of theoretical foundations, e.g. via a compulsory module, can promote theory-based reflection, a portfolio task could, for example, stimulate further discussion of interprofessionality.

Although the scope of the findings presented here is limited, due to a sample size of eight surveyed students, they offer an encouraging impetus to turn more systematically to the conceptual development and design of interprofessional teaching-learning arrangements in educators' training for health professions and to anchor them in the module design.

References

Achtenhagen, F. (2004). Prüfung von Leistungsindikatoren für die Berufsbildung sowie zur Ausdifferenzierung beruflicher Kompetenzprofile nach Wissensarten. In M. Baethge, K. P. Buss, & C. Lanfer (Eds.), *Expertisen zu den konzeptionellen Grundlagen für einen Nationalen Bildungsbericht* (pp. 11–32). Berlin: BMBF.

Botma, Y. (2019). Consensus on interprofessional facilitator capabilities. *Journal of Interprofessional Care, 33*(3), 277–279. DOI: 10.1080/13561820.2018.1544546

CAIPE – Centre for the Advancement of Interprofessional Education. (2002). *Interprofessional Education – Today, Yesterday and Tomorrow. A review.* Fareham UK: CAIPE.

Dörnyei, Z. (2007). *Research methods in applied linguistics*. New York: Oxford University Press.

Dresing, T., & Pehl, T. (2015). *Praxisbuch Interview, Transkription & Analyse. Anleitungen und Regelsysteme für qualitativ Forschende* (6th ed.). Marburg: Eigenverlag.

Ewers, M., & Walkenhorst, U. (2019). Interprofessionalität in den DACH-Ländern – eine Momentaufnahme. In M. Ewers, E. Paradis, & D. Herinek (Eds.), *Interprofessionelles Lernen, Lehren und Arbeiten. Gesundheits- und Sozialprofessionen auf dem Weg zu kooperativer Praxis* (pp. 20–37). Weinheim: Beltz-Juventa.

Flick, U., von Kardorff, E., & Steinke, I. (2015). Was ist qualitative Forschung? Einleitung und Überblick. In U. Flick, E. von Kardorff, & I. Steinke (Eds.), *Qualitative Forschung – ein Handbuch* (11th ed., pp. 13–16). Hamburg: Rowohlt Taschenbuch Verlag.

Gesundheitsministerkonferenz (GMK), & Kultusministerkonferenz (KMK). (2015). *Fachkräftesicherung im Gesundheitswesen: Gemeinsamer Bericht.* Beschluss der Kultusministerkonferenz vom 12.06.2015. Beschluss der Gesundheitsministerkonferenz vom 24./25.06.2015.

Handgraaf, M., Klemme, B., & Nauerth, A. (2004). *Entwicklung eines Prüfungsinstrumentes zum Clinical Reasoning in der Physiotherapie* (Berichte aus Lehre und Forschung 14). Bielefeld: Fachhochschule Bielefeld.

Hammick, M., Freeth, D., Koppel, I., Reeves, S., & Barr, H. (2007). A best evidence systematic review of interprofessional education. BEME Guide no. 9. *Med Teach, 29*(8), 735–751. DOI: 10.1080/01421590701682576.

Harden, R. M., Stevenson, M., Wilson Downie, W., & Wilson, G. M. (1975). Assessment of Clinical Competence using objective structured examination. *Br Med J., 1*(5955), 447–451. DOI: 10.1136/bmj.1.5955.447.

Helfferich, C. (2011). *Die Qualität qualitativer Daten. Manual für die Durchführung qualitativer Interviews* (4th ed.). Wiesbaden: VS Verlag für Sozialwissenschaften.

Hochschulrektorenkonferenz (HRK). (2017). *Interprofessionelles Lehren und Lernen in hochschulisch qualifizierten Gesundheitsfachberufen und der Medizin. Impulspapier des Runden Tisches Medizin und Gesundheitswissenschaften des Projekt nexus der HRK*. https://www.hrk-nexus.de/fileadmin/redaktion/hrk-nexus/07-Downloads/07-01_RT_Med_Ges/Impulspapier-Lang_mit_Links.pdf.

Jaeggi, E., Faas, A., & Mruck, K. (1998). Denkverbote gibt es nicht! Vorschlag zur interpretativen Auswertung kommunikativ gewonnener Daten. *Forschungsbericht aus der Abteilung Psychologie im Institut für Sozialwissenschaften, 2–98*. Berlin: Technische Universität Berlin, Institut für Sozialwissenschaften, Abt. Psychologie.

Jünger, J. (2019). *Berufsübergreifend Denken – Interprofessionell Handeln. Empfehlung zur Gestaltung der interprofessionellen Lehre an den medizinischen Fakultäten*. Mainz: Institut für medizinische und pharmazeutische Prüfungsfragen.

Kälble, K. (2019). Interprofessionalität in der gesundheitsberuflichen Bildung im Spannungsfeld von beruflicher Identitätsentwicklung und Professionalisierung. In M. Ewers, E. Paradis, & D. Herinek (Eds.), *Interprofessionelles Lernen, Lehren und Arbeiten. Gesundheits- und Sozialprofessionen auf dem Weg zu kooperativer Praxis* (pp. 70–84). Weinheim: Beltz-Juventa.

Keller, R. (2012). *Das Interpretative Paradigma. Eine Einführung*. Wiesbaden: Springer VS.

Kruse, J. (2015). *Qualitative Interviewforschung. Ein integrativer Ansatz* (2nd ed.). Weinheim, Basel: Beltz Verlag.

Lamnek, S., & Krell, C. (2016). *Qualitative Sozialforschung* (6th, rev. ed.). Weinheim, Basel: Beltz Verlag.

Mackay, S. J. (2002). *Interprofessional education: An action learning approach to the development and evaluation of a pilot project at undergraduate level*. Salford: Revans Institute for Action Learning and Research, University of Salford.

Merton, R. K., & Kendall, P. L. (1979). Das fokussierte Interview. In C. Hopf, & E. Wingarten (Eds.). *Qualitative Sozialforschung* (pp. 171–204). Stuttgart: Klett-Cotta.

Nikendei, C., & Jünger, J. (2006). OSCE – praktische Tipps zur Implementierung einer klinisch-praktischen Prüfung. *GMS Z Med Ausbild, 23*(3), Doc47. http://www.egms.de/de/journals/zma/2006-23/zma000266.shtml.

Nock, L. (2016). Interprofessional teaching and learning in the health care professions: A qualitative evaluation of the Robert Bosch Foundation's grant program "Operation Team". *GMS J Med Educ, 33*(2), Doc16. https://dx.doi.org/10.3205/zma001015.

Pawelleck, A., Reisas, S., & Riewerts, K. (2020). *Netzwerk Scholarship of Teaching and Learning*. MACAU Kiel.

Reetz, L. (1990). Zur Bedeutung der Schlüsselqualifikationen in der Berufsbildung. In L. Reetz, & T. Reitmann (Eds.), *Schlüsselqualifikationen* (pp. 16–35). Hamburg: Feldhaus.

Reeves, S., Pelone, F., Harrison, R., Goldman, J., & Zwarenstein, M. (2017). Interprofessional collaboration to improve professional practice and healthcare outcomes. *Cochrane Database Syst Rev, 6*(6), CD000072. DOI: 10.1002/14651858.CD000072.pub3.

Robert Bosch Stiftung. (2011). *Memorandum Kooperation der Gesundheitsberufe. Qualität und Sicherstellung der zukünftigen Gesundheitsversorgung*. https://www.bosch-stiftung.de/sites/default/files/publications/pdf_import/Memorandum_Kooperation_der_Gesundheitsberufe.pdf.

Robert Bosch Stiftung. (2018). *Gemeinsam besser werden für Patienten. Interprofessionelle Lehrkonzepte aus der Förderung der Robert Bosch Stiftung*. Stuttgart.

Roth, H. (1971). *Pädagogische Anthropologie, 2*. Entwicklung und Erziehung. Hannover: Herrmann Schroedel Verlag.

Schlegel, C. (Ed.). (2018). *OSCE – Kompetenzorientiert Prüfen in der Pflegeausbildung. Einführung und Umsetzung von OSCE-Stationen*. Heidelberg: Springer-Verlag.

Schön, D.A. (1983). *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books.

Schroeder, G. (2010). Interprofessionalität in der Umsetzung. *Pflegewissenschaft, 1*, 18–23.

Sieger, M., Ertl-Schmuck, R., & Bögemann-Großheim, E. (2010). Interprofessionelles Lernen als Voraussetzung für interprofessionelles Handeln – am Beispiel eines interprofessionell angelegten Bildungs- und Entwicklungsprojektes für Gesundheitsberufe. *Pflege und Gesellschaft, 15*(3), 197–216.

Sottas, B., Kissmann, S., & Brügger, S. (2016*). Interprofessionelle Ausbildung (IPE): Erfolgsfaktoren, Messinstrument, Best Practice Beispiele*. Expertenbericht für das Bundesamt für Gesundheit Bern, Forschungsberichte Interprofessionalität im Gesundheitswesen. Bern.

Walkenhorst, U., Mahler, C., Aistleithner, R., Hahn, E.G., Kaap-Fröhlich, S., Karstens, S., Reiber, K., Stock-Schröer, B., & Sottas, B. (2015). Positionspapier GMA-Ausschuss – Interprofessionelle Ausbildung in den Gesundheitsberufen. *GMS Z Med Ausbild, 32*(2), Doc22. DOI: 10.3205/zma000964.

Wesselborg, B. (2017). *Interprofessionelles Lernen in den Gesundheitsberufen: Hochschuldidaktische Konzeption einer Lehrveranstaltung für Pflege- und Medizinstudierende*. 19. Hochschultag Berufliche Bildung der Universität Köln.

Wissing, C., Kerres, A., & Lüftl, K. (2017). Das Prüfungsformat OSCE im Pflegepädagogikstudium erlernen (Teil 1). *Pflegezeitschrift,* 70(5), 36–39.

Wissenschaftsrat (WR). (2012). *Empfehlungen zu hochschulischen Qualifikationen für das Gesundheitswesen*. https://www.wissenschaftsrat.de/download/archiv/2411-12.pdf.

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Buchvorstellungen

van de Ven, Angèle; Schmit Jongbloed, Lodewijk. (2020): Arzt & Ärztin als Ganzes – sinnvoll arbeiten, sinnvoll leben. Oegstgeest: Schmit Jongbloed Advies Verlag, ISBN 978-9082518788, 108 Seiten.

Die psychische Gesundheit von Ärztinnen und Ärzten ist wesentlich, damit diese ihren Beruf motiviert und konzentriert ausüben können. Aufgrund von hoher Arbeitsbelastung leiden Medizinerinnen und Mediziner jedoch häufiger an Burn-out-Symptomen und sind anfällig für Depression, Sucht oder körperliche Beschwerden. Dieses handliche und unkonventionelle „Karriere-Handbuch" für Ärztinnen und Ärzte stammt ursprünglich aus den Niederlanden und wurde nun für die Medizin in Deutschland angepasst und übersetzt. Es hat zum Ziel, Medizinerinnen und Mediziner jeden Lebensalters zu einer Selbstreflexion anzuregen, die der kontinuierlichen persönlichen und professionellen Weiterentwicklung dient. So können Ärztinnen und Ärzte lernen, ihre eigenen Grenzen und Ressourcen besser wahrzunehmen und so dem Verlust ihrer Leidenschaft und Motivation entgegen zu wirken.

Kriwy, Peter; Jungbauer-Gans, Monika (Hrsg.). (2020): Handbuch Gesundheitssoziologie. Wiesbaden: Springer VS, ISBN 978-3-658-06421-1, 816 Seiten.

Dieser aktuelle Band umfasst verschiedene Perspektiven und Zugänge zur Gesundheitssoziologie. Insgesamt 37 Einzelbeiträge von renommierten Expertinnen und Experten ermöglichen eine konzise und zugleich reichhaltige Einführung in das Themengebiet und seine Vertiefungsbereiche. Zu Beginn wird eine grundsätzliche Klärung des Begriffs „Gesundheit" vorgenommen und einflussreiche soziologische Konzepte, Methoden und Messansätze vorgestellt. Zahlreiche Beiträge vertiefen in der Folge die Frage nach der ungleichen Verteilung von Gesundheit und Krankheit in der Gesellschaft, und nach deren Entwicklung über die individuellen Lebensverläufe in sozialen, sich über die Zeit wandelnden Kontexten. Ausführlich werden auch strukturelle Aspekte behandelt, die sich an Organisationen (allgemein und der Gesundheitsversorgung), an Regionen und Umweltfaktoren sowie an verschiedenen Akteuren im Gesundheitssystem und der Gesundheitspolitik festmachen. Zuletzt wird das Thema der Gerechtigkeit im Bereich der Gesundheit und Versorgung diskutiert, z. B. vor dem Hintergrund endlicher Ressourcen und den Grenzgebieten von Gesundheit und Krankheit, in dem sich u. a. die Reproduktionsmedizin bewegt.

Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V (MFT). (2015): Nationaler Kompetenzbasierter Lernzielkatalog Medizin (NKLM). https://nklm.de/ (Zugriff 28.04.2021)

Der Nationale Kompetenzbasierte Lernzielkatalog Medizin definiert Kompetenzen, die sich am Berufsbild des Arztes orientieren und die nach Abschluss des humanmedizinischen Studiums vorliegen sollten. Dazu zählen neben Wissen und Fertigkeiten auch übergeordnete Lernziele wie Haltungen, Wissenschaftskompetenzen und sogenannte Soft Skills. Er entstand in über sechsjähriger Entwicklungsarbeit durch eine Arbeitsgruppe des Medizinischen Fakultätentags (MFT) und der Gesellschaft für Medizinische Ausbildung (GMA) sowie mehr als 200 Experten aus Fachgesellschaften, der Bundesärztekammer, der Bundesvereinigung der Medizinstudierenden Deutschlands (bvmd) und der Medizinischen Fakultäten. Er dient den Fakultäten als Empfehlung und Leitlinie bei der Weiterentwicklung des Curriculums sowie innovativer Lehr- und Prüfungsformate und soll fortlaufend unter wissenschaftlichen Gesichtspunkten angepasst und optimiert werden. Mit diesem Großprojekt hat die universitäre Medizin sich zentralen Herausforderungen der Nachwuchsausbildung gestellt und operationalisierbare kompetenzbasierte Lernziele in einem breiten Konsens verankert. Diese rücken ein breiteres Spektrum an Fähigkeiten in den Blickpunkt als die bisher verbindlichen Kataloge und machen transparenter, was für eine zukunftsfähige Medizinerausbildung gelehrt, gelernt und geprüft werden soll.

Vögele, Jörg; Knöll, Stefanie; Noack, Thorsten (Hrsg.). (2021): Epidemics and Pandemics in Historical Perspectives. Wiesbaden: Springer VS, ISBN 978-3-658-13875-2, 448 Seiten.

Im Zentrum dieses Sammelbands stehen aktuelle Forschungsergebnisse interdisziplinärer Autorinnen und Autoren aus sieben Ländern zum Thema Seuchen, und die 27 einzelnen Beiträge des Bands behandeln epidemisches Geschehen vom Mittelalter bis in die Neuzeit in allen Weltregionen. Alle Seuchen verbreiten zunächst Unsicherheiten in der Gesellschaft, sodass bei ihrem Auftreten historische Analogien herangezogen werden, um Gefahren zu erkennen und Gegenmaßnahmen zu treffen – ein Muster, das sich über Jahrhunderte zurückverfolgen lässt und auch zu erfolgreicher Planung von Prävention und Bekämpfung führen kann. Die medizinische Seuchengeschichte – in enger Verknüpfung mit Sozial-, Wirtschafts-, Kultur- und Wissenschaftsgeschichte – kann daher wesentlich zum Verständnis aktueller Entwicklungen beitragen. Einführend und abschließend werden Forschungsstand und -perspektiven zur Sozialgeschichte der Medizin diskutiert.

Last but not least

Dr. Frank Wissing

Dr. Frank Wissing is secretary general of "Medizinischer Fakultätentag (MFT)". He studied biology at the University of Osnabrück and did his doctorate in the Department of Plant Sciences at the University of Oxford. After postdocs in Cambridge and Heidelberg, he began his work in 2002 as a consultant and later programme director in the field of medicine. In addition to changing research focus within medicine, he also headed the joint funding programme "Clinical Trials" of the "Deutsche Forschungsgemeinschaft (DFG)" and "Bundesministerium für Bildung und Forschung (BMBF)". Since 2016, Dr. Frank Wissing has represented the medical faculties in all matters of teaching and research as MFT secretary general.

What fascinates you about higher education and education in general?

At universities, knowledge is continuously created in research, new ideas are born and old ideas are also discarded. And this knowledge, but also the critical and reflective handling of it, must be passed on. It is the people, with all their peculiarities and creativity, but also their willingness to cooperate and communicate, who make the university system possible in the first place. I find this productive complexity fascinating! In university medicine, another dimension is patient care – with the aim of curing diseases and preserving health. In all of this, the human being is at the heart of it.

How would you describe your own academic career?

I have always enjoyed turning to new questions and topics. In my studies, I therefore enjoyed the breadth and abundance of topics in biology and also continuously devoted myself to very different questions in my own research time. This may have slowed me down in my academic career because it meant I had to keep building up new networks. But that made the job at the DFG all the more exciting – I was able to work on many varied topics and accompany researchers from all areas of medical research. This plus the opportunity to help shape the science system in both teaching and research also fascinate me about my current job at the MFT.

Why did you decide to study at the University of Osnabrück back then?

Studying in Osnabrück was initially a pragmatic decision. I decided to study biology without having a clear idea of a future professional career. The only biologist I knew was my biology teacher. And in the wider family circle, I was one of the first to study at all. The acceptance for a place at Osnabrück proved to be a stroke of luck. As a small university, there was great proximity to other students and teachers, both in biology and with other subjects. And the biology programme was of a high standard!

What was your best experience during your studies?

The practical courses and excursions. Under great professional guidance, we experienced and analysed the interrelationships of nature. I still like to return to the places at Lake Dümmer or in the Teutoburg Forest. And my passion for bird watching has also stuck with me.

Which courses did you not like at all?

The biochemistry lectures did not inspire me at all. Unfortunately, the lecturer did not encourage this either. Fortunately, there was the Stryer textbook with its excellent didactic layout and our joint study group. We then taught ourselves the inner beauty of the citrate cycle.

Looking back, how would you rate studying at your alma mater and why?

The manageability of a medium-sized city with its small university made me feel welcome from day one. I immediately felt at home. I simply enjoyed my studies because I was able to choose from a wide range of topics. Being able to use the courses freely and, if necessary, to shape my curriculum myself was incredibly beneficial. After five years there, however, I had the feeling that I had seen everything. That's why I moved on to England.

Who or what influenced you most during your studies?

Life beyond the curriculum! The freedom to organise my own day, to get a taste of lectures in other degree programmes, to meet friends, to travel, to get involved in politics and to take responsibility for all of this myself.

What characteristics should a university have today in order to be or remain fit for the future?

A university must continue to offer opportunities and freedom for the development of students. This includes clearly formulated requirements, but also the space, literally and figuratively, for exchange with teachers and, even more so, with fellow students. Not every student can handle this freedom and responsibility in the same way. Therefore, the proximity of the university to its students is essential in order to be able to compensate for this if necessary.

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Index 2021

English abstracts of all articles can be found on the first pages of the respective issue. The page numbers below refer to the full articles.

Wir danken dem Herausgeberbeirat
sowie allen anonymen Gutachterinnen und Gutachtern
für ihre wertvolle Arbeit.

We would like to thank the editorial board and
all the anonymous reviewers for their valuable contribution.

Hinweise für Autorinnen und Autoren

Konzept:
Die Zeitschrift „Beiträge zur Hochschulforschung" bietet Hochschulforschenden und Akteuren im Hochschulbereich die Möglichkeit zur Erstveröffentlichung von Artikeln, die wichtige Entwicklungen im Hochschulbereich aus unterschiedlichen methodischen und disziplinären Perspektiven behandeln. Dabei wird ein Gleichgewicht zwischen quantitativen und qualitativen empirischen Analysen, Vergleichsstudien, Überblicksartikeln und Einblicken in die Praxis angestrebt.

Eingereichte Artikel sollten klar und verständlich formuliert, übersichtlich gegliedert sowie an ein Lesepublikum aus unterschiedlichen Disziplinen mit wissenschaftlichem und praxisbezogenem Erwartungshorizont gerichtet sein.

Review-Verfahren:
Wie für eine wissenschaftliche Zeitschrift üblich, durchlaufen alle eingereichten Manuskripte eine externe Begutachtung durch anonyme Sachverständige (double blind). Dabei kommen je nach Ausrichtung des Artikels folgende Kriterien zum Tragen: Relevanz des Themas, Berücksichtigung des hochschulpolitischen Kontexts, Praxisbezug, theoretische und methodische Fundierung, Qualität der Daten und empirischen Analysen, Berücksichtigung der relevanten Literatur, klare Argumentation und Verständlichkeit für ein interdisziplinäres Publikum. Die Autorinnen und Autoren werden über das Ergebnis schriftlich informiert und erhalten gegebenenfalls Hinweise zur Überarbeitung.

Umfang und Form der eingereichten Manuskripte:
Manuskripte sollten bevorzugt per E-Mail eingereicht werden und einen Umfang von 20 Seiten/50 000 Zeichen mit Leerzeichen nicht überschreiten (Zeilenabstand 1,5, Arial 11). Ergänzend sollten je ein Abstract (maximal 1000 Zeichen mit Leerzeichen) in deutscher und in englischer Sprache sowie Anschrift und Angaben zur beruflichen Funktion des Autors beigefügt sein. Die Druckfassung wird extern von einem Graphiker erstellt.

Bitte beachten Sie in jedem Fall bei Einreichung eines Manuskripts die ausführlichen verbindlichen Hinweise für Autoren unter http://www.bzh.bayern.de.

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Aus dem Inhalt

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