Strategic choices in curriculum design to facilitate knowledge and competency development
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General Discussion
IN THIS THESIS we investigated how educational change can be used to facilitate students’ knowledge and competency development. Comparing a competency-based curriculum and its predecessor, we found that students in both curricula performed equally well in clinical practice and felt equally well-prepared for practice at graduation. Students in a competency-based curriculum demonstrated a slight knowledge loss compared to students in a primarily knowledge-based curriculum. However, this difference was not found at the end of the curriculum. In the clinical phase we found that having students rotate through a selection of clinical rotations to promote longer rotations is feasible with respect to knowledge and competency development. Not rotating through a clerkship will lead to students missing out on discipline-specific knowledge. Furthermore, after finishing a clerkship, this knowledge decreases significantly over time. We also found that a group of stakeholders considered all disciplines suitable for the development of almost any competency. In the preclinical phase, we found cumulative assessment to benefit student study behaviour. Students who initially scored low or high in a cumulative assessment programme were shown to improve and maintain their scores, respectively. Furthermore, students in a cumulative assessment programme were shown to spend significantly more time on self study than students in an end-of-course assessment programme.

ON KNOWLEDGE DEVELOPMENT

Knowledge development runs like a thread through this thesis. It is addressed in four out of our five studies. The implications of the findings of each individual study are presented in their respective chapters. However, several findings and themes emerge when we look at the findings overall.

Our findings on cumulative assessment add significant evidence to the discussion of whether assessment can drive learning. Many have said that assessment should be used to drive learning.\textsuperscript{1-5} Opponents claim that evidence for this statement is lacking.\textsuperscript{4,6} In Chapters 5 and 6 we showed that cumulative assessment can be used to encourage students to study more regularly and study substantially more in general. Furthermore, we found evidence that, given enough time between tests, initially low-scoring students will improve their scores, while initially high-scoring students will maintain their high scores. These findings offer considerable support for the statement that assessment drives learning and show that cumulative assessment can be used to benefit at least initially low-scoring students.

The finding that cumulative assessment can drive student learning raises two important questions which should be addressed in further research. First, how does cumulative assessment drive student
learning? Cumulative assessment consists of a combination of different assessment principles, such as frequent testing, repetition of content and compensation across tests, and feedback between tests. It is uncertain which of these principles or what combination of these principles is most effective. The results from our experiment suggest that at least the planning of tests plays an important role in student study behaviour, as we observed a considerable increase in self-study time as test dates came closer. However, the other assessment principles might have contributed to this phenomenon. Alternatively, it could very well be that some principles influence when students study, while others, such as repetition of content and feedback, influence what students study. Further research should aim to unravel how the separate parts of cumulative assessment influence student study behaviour.

A second, related question concerns whether cumulative assessment, as we investigated it, is designed optimally to benefit student learning or whether there remains room for improvement. For example, research into knowledge retention has shown that retention is optimal when retesting knowledge is done at increasing time interval. Cumulative assessment in its current form features decreasing time intervals between tests: a four-week interval between the first and second test, and a two-week interval between the second and third test. Perhaps, starting with a shorter interval and then increasing the duration of the time interval as the course continues could benefit students’ knowledge retention more than the current system. Future research should determine what intervals lead to optimal results. Another example concerns the content and modus of the feedback students receive in cumulative assessment. In the current programme, students receive information on which questions they have answered correctly, through a digital learning environment. Its strength is that students can seek feedback at a time when they can process the feedback optimally. However, it is uncertain whether all students make use of this feedback. Literature suggests that structural and information-rich feedback is beneficial for student learning. Whether cumulative assessment would benefit from more structured modes of delivering feedback or more information-rich feedback could also be a topic for further research.

From the results in chapters 2 and 4 we learned that knowledge continues to develop during clerkships. This is in line with earlier research. It emphasises that students keep accumulating new declarative knowledge, even while simultaneously encapsulating existing knowledge and developing illness scripts. As students progress through the curriculum their knowledge is transformed into causal networks, and then illness scripts, which facilitate efficient and effective diagnostic reasoning and decision making. This process of transformation mostly occurs in practice where preclinical knowledge is applied to actual cases. Such complex knowledge structures are not measured by declarative knowledge tests and do not represent the increasing scores we found. Therefore, our findings suggest that the development of basic knowledge is an ongoing process, even at the end of undergraduate education. It raises the question of how knowledge develops throughout the medical education continuum.
In Chapter 2 we found that reserving time for competency development at the expense of time specifically reserved for knowledge development leads to a slight loss in knowledge development. Apparently, students in the competency-based curriculum developed their declarative knowledge to some extent more slowly than students in the previous curriculum. Intuitively, this finding could be thought to be related to the changes that were made in the clerkship programme. After all, one change was that students stopped rotating through every discipline during clerkships. Furthermore, in Chapter 4 we found evidence that students develop less discipline-specific knowledge when they do not rotate through a discipline. Consequently, part of the loss in knowledge development can be explained by the students acquiring less discipline-specific knowledge related to disciplines that they did not rotate through. However, we feel this is unlikely for two reasons. First, there were no differences in knowledge scores near the end of the curriculum in any of the cohort comparisons in Chapter 2. Second, when a student does not rotate through one discipline he is rotating through another. This means that students just develop knowledge of different topics rather than less knowledge.

Concerning competency development, this thesis adds to the literature in two ways. First, by addressing knowledge development as an important condition for competency development. Each competency represents the integrated application of certain knowledge, skills and professional behaviour. Without appropriate knowledge, competency development would be impossible for students. Therefore, the findings described earlier concerning knowledge development also offer useful insights for those aiming to facilitate competency development. After all, practicing competencies, such as taking someone's medical history, would lose all authenticity without the presence of the necessary knowledge structures to understand the patients' complaints and illnesses.

Second, this thesis focuses on the suggestion that competency development can be facilitated by more longitudinal attachments during clerkships. Longitudinal attachments potentially allow students to build more meaningful relationships with patients, supervisors and other health care professionals.

Our studies in chapters 3 and 4 offer evidence that the increase in clinical rotation duration could be feasible. Under the rationale that longer rotations mean fewer rotations, we found support for the
feasibility of longer clerkships with respect to competency development. All disciplines were judged as suitable for learning most competencies. Furthermore, we found that the negative effects of not rotating through disciplines on students’ knowledge development may be mitigated. After all, even though students develop less discipline-specific knowledge, this knowledge also decreases significantly after a clinical rotation is finished. However, we also know that relearning information is a far easier process than learning it.\textsuperscript{24,25} This raises the question of whether and to what extent not rotating through certain disciplines as well as the forgetting that occurs after a rotation negatively affects the availability of such knowledge at later stages of medical students’ careers. One way to find out would be to investigate how much discipline-specific knowledge is accessible at several points after graduation.

Perhaps our most important finding regarding competency development is that most competencies can probably be learned in many different contexts. This is an encouraging finding as we want students to become broadly developed doctors, capable of working in an increasingly specialized, fragmented medical field.\textsuperscript{26} Its implication is that students can learn a comprehensive set of competencies in very different combinations of contexts. This offers possibilities with regard to creating the call for continuity in the clinical phase.\textsuperscript{27,28} It also potentially offers us ways to influence students’ career choices by offering them meaningful thematic combinations of rotations. Exposure to specific combinations of rotations and patient groups, for instance, could be used to increase the odds that certain students will choose careers in alignment with societal needs.

The question still remains whether longitudinal attachments are really beneficial for student competency development. As yet, empirical evidence for this widely supported statement is mostly lacking. Some evidence is emerging for a special form of longitudinal attachment in the clinical phase – longitudinal integrated clerkships. Longitudinal integrated clerkships are a very specific format where students are longitudinally attached to a general or family practice, from where they then longitudinally follow one or more patients at a time.\textsuperscript{29} This format for the clinical phase has been widely advocated recently and has been adopted in an increasing number of medical schools.\textsuperscript{30,31} Students in such clerkships perform equally well or better than students in rotational formats on knowledge and skills tests.\textsuperscript{29,32–35} Furthermore, students gain greater awareness of the patient experience and the healthcare system and they seem to be able to assess themselves more accurately.\textsuperscript{29,34,36} All these factors could contribute to better competency development, but whether they are actually successful in doing so is still uncertain. Furthermore, it has been correctly noted that most of the evidence for longitudinal integrated clerkships is preliminary and whether this format offers any long term benefits have yet to be established.\textsuperscript{37}

The recent interest in longitudinal integrated clerkships resonates with one of the key findings in Chapter 3 – that family practice is perceived as being very suitable for learning a considerable part of the competencies we want our students to master during the clinical phase. This is probably because primary care offers the most diverse caseload. Family practice may offer the benefits of longer attachment without the risk of a lower diversity caseload. Therefore, we feel that if longer
rotations are implemented, family practice should play a key role. Of course, the feasibility of such wide involvement of family practice is necessarily limited by local healthcare infrastructure and logistic limitations, such as the ratio between available family practitioners and the number of students.

A theme for future research concerns professional behaviour. As mentioned in the introduction of this thesis, what competency-based medical education brings new to the table is the notion that knowledge and skills should be meaningfully integrated with professional behaviour. As such, research into medical professionalism has received important impetus. However, in our curriculum study (Chapter 2), the focus on professional behaviour was new in competency-based education and there was no available baseline to measure any effect of its implementation on professionalism. As a corollary, it is uncertain how and whether competency-based curricula contribute differently to students’ professional development than other curricula. Future research could address this issue in two ways. First, medical schools who have not yet adopted competency-based education could carry out a pre and post measurement of professional development. Second, whether the standards that have been formulated in competency frameworks are truly met in practice and after graduation should be explored. Such research should help us ascertain whether our competency-based curricula achieve their goals.

**METHODOLOGICAL CONSIDERATIONS**

The studies in this thesis were mainly carried out in naturalistic settings, except the study in Chapter 3. Consequently, we mostly measured student outcomes in an actual high-stake educational setting. This increases the ecological validity of our findings, meaning they are more easily generalizable to real life educational settings and daily practice. However, naturalistic studies also have a downside. Given the specific context of each medical school and each healthcare system, it remains difficult to generate results which can be applied in every country or medical school. Furthermore, it can be very challenging to deduce whether an observed effect can be attributed to a planned intervention or whether other factors in the curriculum might have also contributed. It has been suggested that the latter is especially true of research at a curriculum level, such as the study in Chapter 2. We found few differences between the two curricula we studied and the effects that were found were hard to attribute to the curriculum change. However, we feel that even though it may be challenging to interpret the outcomes of research at the curriculum level, findings at this level can still be informative and guide us to meaningful research questions. For example, they raise the question of why explicitly paying attention to competencies did not increase students’ preparedness for practice or how students’ knowledge development can be maintained.
To some extent, the current thesis presents us with a streetlights and shadows problem. The streetlights and shadows effect refers to the fact that when we lose something, we often look for it where there is light, even though we may have lost it somewhere else. The studies in this thesis focus on very relevant measures, mostly regarding declarative knowledge, because such measures were available in the existing curriculum. However, other important pieces of the puzzle might have been left in the shadows because no tools were available to us to measure them on a large scale or to measure them at all. The progress test and the tests used in cumulative assessment address factual knowledge and basic relationships between concepts. However, the relationship between students’ declarative knowledge and future performance in practice is indirect since students mainly develop expertise by applying their knowledge in practice. Therefore, acquiring sufficient declarative knowledge is no guarantee for becoming a good doctor, but is merely a prerequisite to construct more meaningful knowledge structures. Furthermore, in addition to declarative knowledge and expertise, students should also develop procedural knowledge, especially during clerkships. Procedural knowledge concerns knowledge about how certain tasks should be performed in order for them to be executed successfully. Both procedural knowledge and the development of more meaningful knowledge structures are important for students to become competent practitioners. Tools for measuring procedural knowledge and more complex knowledge structures could enrich further research into both competency-based education and knowledge development.

An important methodological lesson is that measuring knowledge using tests remains difficult without a priori information about characteristics of test items – item difficulty especially. Lacking knowledge about what a students’ score on an item should mean can have a detrimental effect on the inferential power of any research design. Without knowledge about how difficult a test is, it is hard to say whether students performed well or not. Furthermore, lacking information on test difficulty can make the comparability of tests, indeed, daunting. In our exploratory study on cumulative assessment (Chapter 5) we found a way of working around this. We described different hypotheses for different scenarios, correcting for both regression to the mean and fluctuating test difficulty. This methodology is an example of how we can deal with missing information about the difficulty of test items. Nevertheless, when researching student test performance, using test items of which the difficulty is known through previous measurements or for example an Angoff procedure is preferable. Unfortunately, naturalistic studies are often restricted to available outcomes measures. As a corollary, studies concerning students’ test performance often have to rely on teacher-made tests.

In that respect and in others, the Dutch interuniversity progress test has been invaluable to our research. Our research demonstrates its utility for benchmarking. In our study, comparing two curricula, we showed how we used a benchmarking method adapted from Muijtjens et al. to compare our medical school to others, in order to say something about the effectiveness of our new curriculum. Our research into the effect of clinical rotations on discipline-specific knowledge (Chapter 4),
shows two other advantages of the progress test. First, the progress test is made according to a specific blueprint assessing a range of disciplines and topics with a set number of questions. Consequently, the progress test can be used to measure very specific areas of declarative knowledge over time and to investigate how these areas are affected by educational interventions. Second, the progress test offers information about the item difficulty from a much larger group than the students in a study sample, a student cohort or even a medical school. This offers researchers the opportunity to determine item difficulty relatively independently from the sample.

PRACTICAL IMPLICATIONS

Our findings have several implications for practice. First, cumulative assessment is a promising method for stimulating student test preparation in preclinical education. As shown in Chapter 6, cumulative assessment increases students’ self study time dramatically and consequently, their engagement with the study content, in comparison to end-of-block-assessment. Furthermore, the method stimulates students who perform badly initially to improve their scores later on. As such, combining several proven assessment principles has been shown to genuinely benefit student learning.

Our research also offers several recommendations concerning longer clinical rotations. First, as far as knowledge and competency development are concerned, longer clinical rotations can be implemented. Second, if we implement more longitudinal attachments we must consider which disciplines are vital for students to have some experiential knowledge of. Even though students may forget a large part of their discipline-specific knowledge, recalling forgotten knowledge is always easier than accumulating new knowledge and rotating through a specific discipline still yields a considerable increase in declarative knowledge. This does not necessarily imply that students should go everywhere, but this finding invites us to consider which topics students should really have some experience with. Third, our results showed that family practice
and public health and occupational medicine appear to be especially suitable for student competency development in patient management and social and community contexts of healthcare during the clinical phase. Therefore, we recommend making these disciplines mandatory when designing a competency-based clerkship programme that values these areas of competence.

A final implication of our findings is that competency-based education can be implemented without major educational losses. The flip side to this is that no gains were found either. However, we only studied traditional educational outcomes also available in a non-competency-based curriculum. Therefore, implementing competency-based education could yet be found to yield the benefits it promises.

**FINALLY...**

In the 1970s William Spady, in a reflection on contemporary primary and secondary education, coined competency-based education a ‘bandwagon without a definition’, indicating that everybody was getting on board and nobody really knew what they were doing. The field of medical education is more advanced. Since the start of this century, quite a few clear and influential articles have been published with meticulous definitions of what competency-based medical education should entail and how we should formulate competencies as learning outcomes. However, it has also been acknowledged that the competency movement is still in its infancy. Much remains uncertain about how competencies should be learned and how educators can facilitate this process.

Nevertheless, competency-based education is gaining ground every day and perhaps this is not surprising. Whatever its educational benefits, competency-based education has in many instances forced educators and curriculum developers to explicate and question what they want to teach their students and what they are actually teaching their students. Competency-based education offers a unique perspective on a curriculum in the sense that it makes its outcomes, which might have been there already, explicit.

This also implies that the specific effects of competency-based
education may be hard to detect. Much of what is now well defined may have already been part of the curriculum, implicitly or explicitly. Therefore, a future research agenda aiming to unravel what parts of our competency frameworks really are new and what parts were already taught implicitly before implementation may increase our insight into the consequences of implementing competency-based education. Subsequently, it may become easier to uncover the potential benefit of an educational paradigm that has already been widely adopted.
REFERENCES

26. Cassel CK, Reuben DB. Specialization, subspecialization, and


44. Albanese M. Problem-based learning: why curricula are likely to show little effect on knowledge and clinical skills. Med Educ 2000;34:729–38.


51. Spady WG. Competency based education: a bandwagon in search of a
52. Frank JR, Mungroo R, Ahmad Y, Wang M, de Rossi S, Horsley T. Toward a
definition of competency-based education in medicine: a systematic review of
53. Harden RM. Learning outcomes and instructional objectives: is there a
54. Harden RM, Crosby JR, Davis MH, Friedman M. AMEE Guide No. 14:
Outcome-based education: Part 5 - From competency to meta-competency: A