Impact on knowledge acquisition of the transition from a conventional to an integrated contextual medical curriculum

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CONTEXT This study set out to test the hypotheses that after the implementation of an integrated contextual medical curriculum (ICMC), ICMC students would attain higher levels of knowledge in both the basic and clinical sciences at an earlier stage than conventional medical curriculum (CMC) students, that ICMC students would perform significantly better on knowledge tests at the end of their education and, finally, that ICMC students would show a more linear acquisition of knowledge in the basic and clinical sciences.

METHODS We drew upon the Dutch Inter-University Progress Test (PT) to measure impact on knowledge acquisition and compared PT scores of 393 CMC students with scores of 1028 ICMC students (Years 2–6) in a cross-sectional design. We also compared the scores of 112 CMC students with those of 197 ICMC students in Years 3–6 in a longitudinal design.

RESULTS As expected, ICMC students showed a steeper learning curve in both the basic and clinical sciences: at the end of their training students had attained higher levels of knowledge in both domains. The learning curve pertaining to the clinical sciences was almost linear, whereas that for the basic sciences showed a sharper rise, indicating a continuing growth of knowledge.

CONCLUSIONS The differential impact on knowledge acquisition of conventional and innovative curricula has seldom been studied in a longitudinal and cross-sectional design. This study confirmed our assumptions about the potential of an integrated contextual curriculum. The differences observed in ICMC students were attributed to the stronger emphasis on clinically relevant basic sciences in the early years of the ICMC and to the stronger integration of basic and clinical sciences in the ICMC.

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INTRODUCTION

Many curriculum innovations result in the design of learning environments that incorporate principles from cognitive psychology,[1] as well as the more specific recommendations of Regehr and Norman,[2] which state that:

- new information should be linked to available prior knowledge;
- educational strategies should enhance meaningful learning, reduce dependency on particular contexts and provide multiple opportunities to practise;
- learners should be given opportunities to practise problem-solving routines, and
- cases should be presented to learners to foster their reasoning skills.

From a medical education perspective, curriculum innovators expect new medical doctors to be lifelong learners who flexibly adapt to new challenges in their professional environment. Nevertheless, medical institutions fear that curriculum innovations might have a negative impact on levels of knowledge.[3]

However, there is hardly any cross-sectional and almost no longitudinal research available on the impact of the transition from a traditional to an innovatory curriculum on knowledge acquisition by students.

The present study builds on the implementation and evaluation of a comprehensive innovation in the medical curriculum at Ghent University in Belgium. At this university, the conventional medical curriculum (CMC) used to be fully discipline-based. This curriculum was designed in such a way that Year 1 focused completely on the basic sciences, and Years 2 and 3 focused on the biomedical basic sciences and included two and a half years of study in the clinical disciplines and one and a half years of clinical rotations. An external educational quality review of the curriculum in 1997[4] and the adoption of the World Health Organization model of the 'Five-Star Doctor' were the impetus for the development and implementation of a completely new curriculum in October 1999.[5] This implied a switch towards an integrated contextual medical curriculum (ICMC) comprising patient-centred, student-centred, community-oriented, problem-based and evidence-based education.[6] This new curriculum consists of:

1. logical sequences of units, delivered in blocks of 4–6 weeks, in which domain knowledge from a variety of disciplines is presented in an integrated way, and
2. four curricular threads which cross-cut the whole curriculum year after year and include: a focus on skills; exploration of the health system; problem solving, and individual work, including a scientific project carried out during Years 3–6.

In the first two and a half-year cycle the integrated curriculum centres on the healthy and normal body. The attention paid to horizontal integration means that basic science disciplines are not taught as isolated disciplines, but are organised around themes that centre on specific organs.[7] Within the innovative curriculum, attention is also paid to vertical integration. This implies that the curriculum fosters the integration of basic domain knowledge and clinical knowledge.[8–10] Therefore, it draws upon plenty of clinical cases, mirroring real-life situations. As such, students experience at least a partial vertical integration. In the second two and a half-year cycle of the new curriculum, this vertical integration is realised by discussion of the body systems from a clinical point of view, and by the provision of patient demonstrations based on body systems that have already been dealt with in the curriculum.

In order to compare the ICMC and CMC, we can apply a model, designated SPICES, in which a medical curriculum is rated on six characteristics, according to whether it: is *S*tudent-centred versus teacher-centred; is *P*roblem-based versus information gathering-based; is *I*ntegrated versus discipline-based; is *C*ommunity-based versus hospital-based; includes *E*lectives versus a standard programme, and is *S*ystematic versus apprenticeship-based. The ICMC demonstrates a clearly more SPICES-oriented profile compared with the CMC.[11]

A fundamental consequence of curriculum innovation is that traditional examinations can no longer be used as relevant indicators to compare levels of knowledge acquisition across curricula. In an ICMC, tests reflect competencies acquired through multidisciplinary modules, whereas in the conventional curriculum, examinations tested knowledge acquired from separate disciplines. In countries such as Canada and the USA, this drawback is overcome by basing these comparisons on national licensing examinations. In countries where no such independent standardised assessment is available, alternative external and curriculum-independent measures have to be adopted. In the Dutch-speaking regions, we can rely on the Dutch Inter-University Progress Test (PT), which serves as an optimal alternative to traditional curriculum-based measurement instruments.

This test is a valid and reliable instrument which tests medical students' mastery of the knowledge they should have attained by the end of their study. Several publications underpin the value and reliability of the test as an objective assessment instrument.[12–16] It is designed for measuring growth in knowledge acquisition[17] and is, moreover, considered to be an excellent indicator of this growth.[13,18,19] More details of the nature and structure of the test are presented below.

On the basis of the theory described earlier, we hypothesised that clear differences in the level (efficacy) and timing (efficiency) of knowledge acquisition would be observed when comparing ICMC students with students in a conventional curriculum. This assumption was supported by the results of an earlier study, which showed that ICMC students manifest more deep learning, better structuring, more self-regulation and a stronger orientation towards their future profession.[11] These changes may be attributable to aspects of the innovative curriculum, namely, the alternative content and structural design of the ICMC.

In view of these expectations, we formulated three hypotheses:

1. ICMC students will attain the level of knowledge that is to be expected at the end of the curriculum at an earlier stage than CMC students;
2. ICMC students will perform significantly better than CMC students on performance tests at the end of their medical education, and
3. ICMC students will demonstrate a more linear acquisition of knowledge in both the basic and clinical sciences than will CMC students.

METHODS

Participants and procedures

A total sample of 1421 medical students (Ghent University) and 3957 PT scores were analysed in the present study. Table 1 explains the origin of the sub-samples and the extent to which they were involved and thus experienced in a particular medical curriculum.

A first CMC sample consisted of 393 students in Years 2–6 who studied between 1999 and 2003 (1054 PT scores). Most of them (72%) entered medical school after a successful admission test. The year 1999 is of particular importance in the context of this research because the ICMC was introduced during this year.

The second sample consisted of 1028 students in Years 2–6 who studied between 2000 and 2006 at the same university (2913 PT scores), but who started in the new curriculum (ICMC). All these students entered medical education after a successful admission test.

The third sample, which represented a sub-sample of the first and second samples, consisted of 309 students in Years 3–6, of whom 112 studied on the CMC between 1999 and 2003 (22% entered medical education without entrance selection) and succesfully accomplished four successive curricular years, and 197 studied on the ICMC between 2001 and 2006 (all entered medical education with an entrance selection) and succesfully accomplished four successive curricular years.

Measurement instrument: the Dutch Inter-University Progress Test

This test is a comprehensive knowledge test aimed at testing mastery of functional knowledge and attuned to mastery at graduate level. The test was produced jointly by experts from four Dutch medical schools and is normally administered to all students – independent of their study year – four times per year in order to assess the gradual increase in knowledge acquisition of medical students.

The test uses items in multiple-choice (true/false/don't know) format covering three knowledge domains:

1. basic sciences: 65–81 questions about anatomy, physiology, biochemistry, pharmacology, pathology and genetics;
2. clinical sciences: 130–147 questions about surgery, dermatology, gynaecology and obstetrics, family medicine, internal medicine, otorhinolaryngology, paediatrics, neurology, ophthalmology and rehabilitation sciences, and
3. behavioural and other sciences: 27–45 questions about epidemiology, meta-medicine, psychology, psychiatry and social medicine.

Statistical analysis and score equating

Prior to statistical analyses, datasets were examined for accuracy of data entry, missing values, outliers and normality. Comparisons of progress test results can be perturbed by differences in the difficulty levels of the

Table 1 Participation rates of conventional medical curriculum (CMC) and integrated contextual medical curriculum (ICMC) student samples and numbers of students in each sample participating in the Dutch Inter-University Progress Test (PT) from 1999 to 2006, at Ghent University

	Curricular year										
	2		**3**		**4**		**5**		**6**		**All**
	Part	***n* (*)**	**Part**	***n* (*)**	**Part**	***n* (*)**	**Part**	***n* (*)**	**Part**	***n* (*)**	***n* (*)**
Academic year											
1999	0.86	95 (0.08)	0.86	107 (0.32)	0.81	122 (0.98)					
Sample 3**			0.60	75							
2000	0.91	84	0.42†	37	0.79	100 (0.27)	0.45†	63			
Sample 3			0.42	37	0.60	75					
2001	0.97	104	0.98	79	0.95	100 (0.11)	0.89	106 (0.28)	0.91	129 (0.98)	
Sample 3			0.63	51	0.42	37	0.60	75			
2002	0.99	119	0.95	97	0.92	85	0.98	94	0.93	112	
Sample 3			0.65	66	0.63	51	0.42	37	0.60	75	
2003	0.95	124	0.99	119	0.94	110	0.93	80	0.93	89	
Sample 3			0.67	80	0.65	66	0.63	51	0.42	37	
2004	0.96	155	0.96	116	0.96	123	0.95	107	0.73	107	
Sample 3					0.67	80	0.65	66	0.63	51	
2005	0.86	159	0.96	146	0.88	110	0.89	111	0.74	111	
Sample 3							0.67	80	0.65	66	
2006	0.87	218	0.93	163	0.88	150	0.99	115	0.80	115	
Sample 3									0.67	80	
All CMC	0.86	95 (0.08)	0.86	107 (0.32)	0.84	322 (0.68)	0.93	200 (0.20)	0.92	330 (0.49)	1054 (0.38)
All ICMC	0.83	963	0.96	720	0.91	578	0.94	413	0.76	239	2913
All CMC sample 3				112 (0.22)		112 (0.22)		112 (0.22)		112 (0.22)	
All ICMC sample 3				197		197		197		197	

* Proportion of students entering medical education without admission test
** Sample 3 refers to the sub-samples of CMC and ICMC students involved in the longitudinal comparisons
† Excluded because participation rates were too low
Plain line = distinction between CMC and ICMC samples; CMC samples are shown above the line
Results of the progress test for Year 1 ICMC students are not taken into account because this study started in 1999, when there were no longer any Year 1 CMC students; thus PT scores for that particular curricular year could not be compared between curricula
This table reports the proportion of students who entered medical education without entrance selection. Entrance selection was introduced in 1997

tests. To avoid the latter bias, test results were equated.

An established procedure was chosen, the mean equation method,[20] in which test scores are considered to differ from one another by a constant amount along the score scale. We calculated the mean score of all test sessions for each CMC and ICMC year. The difference between this mean score and the mean score of a particular test session resulted in a correction value which was added in the case of a positive value and subtracted in the case of a negative one. Only the equated scores were used in the analyses.

As in most studies, scores are expressed as the percentage correct-minus-incorrect score. In view of the research questions of the present study, we omitted the results of the PT section on behavioural and other sciences because too many questions in this section are specific to the Dutch health care system and are not applicable in the Belgian context. Since 1999, all Ghent University students have been invited to participate in the December administration of the PT.

Differences in the characteristics of CMC and ICMC students were analysed to study possible sample bias by means of two sample *t*-tests and chi-squared tests at a *P*-value of 0.01. The following student background variables were controlled in the different student groups: educational level of mother; age; gender; grade point average (GPA) scores, and entrance selection.

To investigate between-group differences that were hypothesised to be related to the differential impact of the medical curricula, analysis of variance was applied to compare PT scores[21] and *F*-values were calculated (one-way ANOVA). Effect sizes were calculated on the basis of Cohen's *d*.[22] A P-value < 0.05 was stated as the level of significance. The Bonferroni corrected P-value for each comparison was < 0.01.

In view of the longitudinal within-subject comparisons, ANOVA one-way repeated measures were applied based on the general linear model. $P < 0.05$ was taken as the level of significance. Trend coefficients were calculated to study consecutive changes over time.

RESULTS

Participation rates in successive administrations of the test of students in the first and second samples varied between 79% and 99%, except for two test administrations of CMC students in Years 3 and 5 of academic year 2000 (Table 1). The organisation of these particular tests was problematic and they were therefore excluded from the cross-sectional analysis.

Participation rates for the third sub-sample of students varied between 63% and 67% for ICMC and 42% and 60% for CMC students. The very low rate (42%) was explained by the same organisational problems that occurred in 2000. Data for 53% of CMC and 65% of ICMC students were incorporated in the longitudinal analysis.

The samples did not differ in terms of educational level of mother, age, gender or GPA scores, except for GPA in the second curricular year (Table 2). In terms of entrance selection, which concerned only CMC samples, the only significant differences related to age and GPA scores.

Table 3 summarises the cross-sectional comparison of PT scores for students in both curricula and at different stages in their education (Years 2–6).

For both the basic and the clinical sciences, ICMC students outperformed CMC students. In the early years of medical education, students progress most in the basic sciences and least in the clinical sciences. In both medical curricula basic science scores were consistently higher. In Years 2–6, both groups showed comparable and nearly parallel growth curves for mastery of the basic sciences. However, growth between Years 2 and 3 was steeper for ICMC students. We noticed that CMC students spent 91% of their time in Year 2 (corresponding to an increase of 10 points between Years 2 and 3) and 82% in Year 3 (score growth of 10 points between Years 3 and 4) studying basic sciences. One year later, between Years 4 and 5, students spent only 38% of their time on the basic sciences and their knowledge scores increased by only 4 points. Between Years 5 and 6, when students spent a minimum of 10% of their time on basic science study, knowledge scores increased by only 3 points.

By contrast, a nearly steady growth in clinical knowledge in ICMC students during curricular Years 2–6 became apparent. Each year clinical knowledge scores increased by 8 points (except between Years 4 and 5, when a particularly high increase of 11 points occurred). The growth pattern in clinical knowledge was very different in CMC students. They allocated 7% of their time to the clinical sciences in Year 3, corresponding to a 5-point growth; 47% in Year 4, corresponding to a 9-point increase; 80% in Year 5, corresponding to an 11-point rise, and 37% in Year 6, corresponding to a 5-point increase. Year 5 students showed a steeper increase in their mastery of clinical knowledge compared with students in the earlier years in both curricula.

The largest effect sizes – when comparing CMC and ICMC students – were observed in Year 3 of the

Table 2 Comparison of student samples in terms of: gender; age; educational level of mother; grade point average scores, and entrance selection

	n		% Male			Age			% mothers without higher education			GPA		
	CMC	ICMC	CMC	ICMC	χ^2	CMC	ICMC	*t*	CMC	ICMC	χ^2	CMC	ICMC	*t*
Samples 1 and 2														
Year 2	95	963	38	37	0.02	19.6	19.4	+ 2.31	38	30	2.22	58.1	69.6	– 10.84*
Year 3	107	720	36	36	0.00	20.5	20.5	– 0.06	42	32	4.02	70.5	69.2	+ 1.73
Year 4	322	578	38	35	0.97	21.6	21.9	– 1.30	37	33	1.11	71.4	70.7	+ 1.14
Year 5	200	413	39	35	0.62	22.7	22.9	– 0.93	38	34	0.95	72.0	73.5	– 2.51
Year 6	330	239	37	38	0.03	23.6	23.7	– 0.99	37	37	0.01	73.7	73.2	+ 1.03
Sample 3	112	197	40	40	0.00	20.4	20.3	+ 1.48	40	35	0.70	73.0	73.2	– 0.31

	n only CMC		% Male			Age			% mothers without higher education			GPA		
Admission test	Yes	No	Yes	No	χ^2	Yes	No	*t*	Yes	No	χ^2	Yes	No	*t*
Year 3	34	73	32	37	0.06	21.4	20.0	+ 11.26*	50	40	0.70	65.0	73.1	– 6.64*
Year 4	157	165	40	36	0.32	21.9	21.4	+ 3.61*	33	40	1.20	71.0	71.8	– 0.72
Year 5	39	161	36	40	0.07	24.0	22.3	+ 5.64*	51	35	2.51	67.1	73.2	– 4.86*
Year 6	163	167	36	38	0.03	23.7	23.4	+ 1.52	42	33	1.81	72.6	74.7	– 3.66*

Independent samples *t*-test: * $P < 0.01$; sign of *t*-test refers to higher (+) or lower (–) score of CMC versus ICMC students
Chi-squared values are Yates-corrected (no samples with $P < 0.01$)
CMC = conventional medical curriculum; ICMC = integrated contextual medical curriculum

curriculum for both the basic and clinical sciences and in all the comparisons for the clinical sciences. In other comparison research concerning the basic sciences, only small effect sizes were observed.

Table 4 compares two sub-samples of CMC and ICMC students from a longitudinal perspective. Students in both curricula showed a significant increase in performance over time. However, a difference in growth patterns can be detected. In relation to mastery of the basic sciences, CMC students displayed an irregular growth pattern.

This is contrary to the steady progress in knowledge acquisition in ICMC students. However, a different pattern emerges when we focus on mastery of the clinical sciences. There was a significant increase in mastery between Years 5 and 6 in CMC students, although this increase was lower than in ICMC students. In general, ICMC students attained consistently higher performance scores in both knowledge domains.

DISCUSSION

The observed mean correct-minus-incorrect scores on the basic (10–41%) and clinical (1–40%) sciences do not differ from those in a large-scale study of 60 491 tests of 3226 Dutch students, which reported scores of 6–38% on the basic sciences and 1–44% on the clinical sciences.[23]

Table 3 Cross-sectional comparison of scores on the Dutch Inter-University Progress Test (PT) (percentage correct-minus-incorrect) for basic and clinical sciences in CMC and ICMC student samples studying at Ghent University from 1999 to 2006 (one-way ANOVA)

	CMC students sample 1		**ICMC students sample 2**			
Curricular year	**Mean PT score (SD)**	**Students, *n***	**Mean PT score (SD)**	**Students, *n***	***F***	**Effect size Cohen's *d***
Basic sciences						
2	9.98 (8.07)	95	14.37 (9.16)	963	20.35†	0.51
3	20.13 (8.81)	107	31.45 (11.69)	720	92.83†	1.09
4	30.15 (11.83)	322	33.46 (11.70)	578	16.52*	0.28
5	34.13 (11.29)	200	37.22 (13.66)	413	7.68*	0.25
6	37.02 (12.61)	330	41.44 (12.63)	239	17.03†	0.35
Clinical sciences						
2	1.02 (4.11)	95	4.74 (5.03)	963	48.60†	0.81
3	6.04 (4.33)	107	13.09 (7.01)	720	102.20†	1.21
4	14.66 (7.07)	322	21.00 (8.17)	578	136.95†	0.83
5	26.14 (9.95)	200	32.09 (10.57)	413	44.46†	0.58
6	31.32 (9.95)	330	40.82 (10.77)	239	108.16†	0.88

* $P < 0.01$
† $P < 0.001$
Effect size based on Cohen's *d*: small effect (> 0.20); medium effect (> 0.50); large effect (> 0.80)
CMC = conventional medical curriculum; ICMC = integrated contextual medical curriculum; SD = standard deviation

Table 4 Results of the general linear model analysis results (ANOVA repeated measures) in relation to differences in the mastery of the basic and clinical sciences between students studying in two different medical curricula. Dutch Inter-University Progress Test (PT) scores (percentage correct-minus-incorrect)

	Mean PT scores for basic sciences		**Mean PT scores for clinical sciences**	
	CMC (*n* = 82)	**ICMC (*n* = 197)**	**CMC (*n* = 82)**	**ICMC (*n* = 197)**
Year	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
3	21.2 (9.2)	30.9 (12.9)	6.7 (4.4)	13.5 (6.8)
4	31.2 (12.9)	34.3 (12.5)	14.1 (7.4)	20.1 (8.0)
5	33.0 (12.5)	38.4 (14.9)	25.4 (10.1)	32.8 (11.2)
6	38.9 (12.6)	42.4 (12.7)	34.4 (11.3)	41.8 (10.4)
Effect of year F-test (*P*-value) effect size	474.0 ($P < 0.001$) large effect size		2252.9 ($P < 0.001$) large effect size	
Effect of year*curriculum F-test (*P*-value) effect size	20.3 ($P < 0.001$) small effect size		6.0 ($P < 0.01$) small effect size	

Multivariate tests evaluate the effect over time of each variable (labelled with 'effect of year') or evaluate the effect of the interaction of time and type of curriculum (labelled with interaction effect: 'year*curriculum')
CMC = conventional medical curriculum; ICMC = integrated contextual medical curriculum; SD = standard deviation

The outcome for the first research question (Will ICMC students attain a high level of mastery at an earlier stage than CMC students?) for results from both the cross-sectional and longitudinal analyses reveals that the level of mastery attained in Year 3 by ICMC students is achieved 1 year later by CMC students. This early and steep increase is consistent with the structure of the innovative medical curriculum. In the ICMC, the basic sciences are linked with the clinical context from Year 2 onwards. As a result, ICMC students clearly outperformed (large effect size) CMC students in Year 3. Meanwhile, it became clear that knowledge gain was lowest between Years 3 and 4, which can be explained by the fact that in Year 3, unlike in all other curricular years, the basic sciences were not integrated with clinical knowledge for a large amount (31%) of total study time. By contrast, we observed a strong correlation between the increase in basic sciences knowledge in CMC students and time allocated to acquiring this knowledge. In ICMC students, we also perceived a high level of achievement in clinical knowledge in Year 5. Students on the CMC did not reach such a high level even in Year 6. Compared with CMC students, ICMC students show a superior yearly increase in mastery of both the basic and clinical sciences. Both parts of the PT can be considered as valid measures for growth in these types of knowledge.[17]

The results of our analysis are also clear in terms of the second research question (Will ICMC students outperform CMC students at the end of their medical training?). Students on the ICMC attained significantly higher performance scores in relation to both the basic and clinical sciences. These results were consistent in the cross-sectional comparison and the longitudinal analysis. We think that the integration of the two knowledge domains results in higher levels of achievement in both types of knowledge. However, both types of sciences were presented separately and in different proportions year-on-year in the CMC. For example, the time allocated to the basic sciences decreased from 91% in Year 2 to 10% in Year 5, whereas we observed the opposite for the clinical sciences, which showed an increase in time allocated from 5% to 80% over the same period.

The answer to the third research question (Will students in the ICMC reflect a gradual and linear increase in mastery of both the basic and clinical sciences, compared with a less continuous growth pattern in CMC students?) is positive concerning the clinical sciences only in cross-sectional comparisons. Although the growth was highest in Year 5, as it was in CMC students, we noticed a yearly increase of 8 points in all other curricular years. This indicates that the ICMC offers a good balance of knowledge. The growth patterns of mastery of the basic sciences in ICMC students and of both sciences in CMC students were more irregular. Acquisition of the clinical sciences very closely reflected the time these students allocated to these sciences year-on-year.

The fact that our expectations have been met – although not always consistently – helps to counter the fear of medical institutions that curriculum innovations might have a negative impact on knowledge acquisition when there is a stronger focus on skills acquisition and the development of professional attitudes.[3]

Additional checks were carried out to study the comparability of the CMC and ICMC student samples. Participants in the ICMC and CMC groups did not appear to differ in terms of age, gender, educational level of mother or GPA scores. Neither were important differences found between students entering medical education with or without entrance selection. Despite this reassuring analysis, results should still be interpreted with caution when considering their generalisation to the entire student population.

Despite the large-scale set-up – involving 10 cohorts of students in a cross-sectional design and two cohorts studied from a longitudinal perspective – an additional limitation should be highlighted. The progress test used in this study was not geared towards all the particularities of the ICMC innovation. This test was, for example, unable to reveal the impact on all the academic and professional competencies that are central to the ICMC.

In this study we did not focus on qualitative studies, such as video assessment methods,[24] studies of students' views about the quality of teaching[25] or ethnographic research about students in a clinical teaching context.[26] Parts of the new curriculum have been evaluated project-wise and focus groups have been organised, mainly in the first two cohorts of the new curriculum, in order to evaluate how the students perceived the impact of this curriculum on their learning.

Future research should analyse long-term knowledge acquisition in particular student cohorts. In addition, new instruments should be developed that are able to capture the mastery of competences that are unique to the ICMC.

CONCLUSIONS

In the medical research literature, longitudinal and cross-sectional studies that study the differential impact of innovations in medical curricula are scarce. In the present study, we compared knowledge acquisition in 10 cohorts of students enrolled in either a CMC or an ICMC. We also used a longitudinal design to compare knowledge acquisition from Years 3–6 in both types of curricula. A curriculum-independent measure – the Dutch Inter-University Progress Test – was used.

Expectations about the potential of the ICMC were confirmed. This curriculum's substantial investment in the integration of the basic and clinical sciences leads to a more gradual, steadier and finally higher level of mastery of clinical knowledge. At the same time, the study showed that a stronger emphasis on the basic sciences in the early years of a curriculum leads to a steeper learning curve in the mastery of clinically relevant basic knowledge. This type of knowledge continues to develop, even without formal teaching in this domain, during the later years of the curriculum.

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