Impact of the Transition from a Conventional to an Integrated Contextual Medical Curriculum on Student's Learning Patterns: a Longitudinal Study

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1. Background

1.1. Introduction

Many institutions have adopted innovative approaches to the medical curriculum in order to optimize graduate preparation for professional life in the 21st century. They expect that new medical doctors are lifelong learners who flexibly adapt to new challenges in their professional environment. The new curricula also expect students to adopt different learning patterns and reposition the role of assessment and evaluation (Shaughnessy & Slawson 1999;Spencer & Jordan 2001). Studying learning patterns is important since they have been found to correlate with study persistence (Makinen, Olkinuora, & Lonka 2004) and with learning outcomes in terms of grades or performance indicators as progress tests or OSCE (Boyle, Duffy, & Dunleavy 2003;Busato et al. 1998;Dejong 1995;Husman & Lens 1999;Lindblom-Ylanne & Lonka 2001;Lynch et al. 1998;Masui & De 2005;Meyer 2000;Pintrich 2000;Schunk 1998;Trigwell & Prosser 1991a;Vermunt 1995).

However, there is hardly cross-sectional and almost no longitudinal research available that studied the impact of a curriculum innovation on learning patterns. Only in one study the effect of promoting a deep approach and the deterring impact of a surface approach to learning was clearly detected (Reid, Duvall, & Evans 2005). But the particular curriculum innovation was rather restricted. In order to fill this gap in medical education research, we designed a naturalistic (Buckley 1998) post hoc study of longitudinal changes in student learning patterns parallel to the implementation of a curriculum innovation. But, to start with, the study first analysed to what extent the innovative curriculum was implemented as it was intended.

1.2. Curriculum context: The Ghent experience: transition from a conventional to an integrated contextual medical curriculum

At Ghent University (Belgium), the conventional medical curriculum used to be fully discipline based. It comprised a first year focused on basic sciences, a second and third year of biomedical sciences, two and a half year of clinical disciplines and one and a half year of clinical rotations.

An external educational quality review in 1997 (Van den Brande et al. 1998) and the adoption of the WHO-model of the ‘five star doctor’ were the impetus for the development and implementation of a new curriculum (De Maeseneer 2003) in October 1999. This implied a switch from a conventional discipline based curriculum towards an integrated and contextual approach: patient-centered; student-centered; community oriented; problem and evidence based (Deveugele et al. 2005). One of the main

educational goals of the new curriculum was to stimulate self-regulation of the student learning processes.

The integrated contextual Ghent curriculum is divided into (1) logical sequences of units, so called 'blocks', of 4 to 6 weeks, in which domain knowledge from a variety of disciplines is integrated; and (2) 'lines', which cross horizontally through the whole curriculum year after year. In each individual curriculum year, four 'lines' focus on skills, exploration of the health system, problem solving and individual work including a scientific project from year 3 to 6.

2. Research approach

The general research question builds on the theoretical base discussed earlier and focuses on the extent to which the curriculum innovation has resulted in changes in student learning patterns. But the question can be asked to what extent the actual implementation of the innovation reflects the intended curriculum innovation. This implies a control of 'treatment fidelity'. This is a critical question since the 'planned, delivered and experienced' curriculum can be significantly different (Prideaux 2003). Therefore, the first research question is 'Does the delivered and experienced curriculums not differ too largely from the planned curriculum innovation?

3. Method

3.1. Treatment fidelity

In view of answering the question to what extent the current implementation of the innovation reflects the intended curriculum innovation, the *delivered* curriculum was evaluated by using the SPICES model (Harden, Sowden, & Dunn 1984), and by monitoring of the *experienced* curriculum by means of measuring the real study-time of students and their experiences of the learning environment (Van der Veken & Derese 2005). Central themes in the SPICES-model are: Student-centred versus teacher-centred; Problem-based versus information gathering; Integrated versus discipline-based; Community-based versus hospital-based; Electives versus standard programme; and Systematic versus apprenticeship-based education. In line with the approach of other researchers (van den Berg 2004), a student, a teacher and an educational staf member assessed both curricula based on these criteria.

3.2. Research subjects of longitudinal comparison

Students involved in the study were enrolled in the matriculating classes of 1998 (conventional curriculum) and 1999 (integrated contextual curriculum) and participated in the study during the first four years of medical education. Questionnaires were distributed eight weeks after the start of the

academic year within three successive years from the 2nd until the 4th study year. Participation was voluntary.

The following student background variables were controlled for: prior educational level and educational level of parents (higher education or not), occupational prestige level (Elchardus 1979;Treiman 1977), age, gender, prior (secondary-school) education (hours of mathematics, sciences, Latin, Greek). In addition information was gathered about final scores secondary school, admission test scores, general point average (GPA) scores and Progress Test scores.

3.2. Statistical Analysis

Prior to analyses, variables were examined for accuracy of data entry, missing values, outliers and normality. Non-response was analysed to study possible sample bias by means of two sample *t*-tests and *chi*-squared tests.

In view of the longitudinal within-subjects comparison *ANOVA* one-way repeated-measures was applied, using the General Linear Model. In this longitudinal within-subject design, only data of subjects who succeeded four successive curricular years were withheld. A p value of $< .05$ was stated as the level of significance. Trend coefficients have been calculated to study the consecutive changes in the dependent variables over time. It was decided not to take into account the data of the first year students because the expected bottom effect (lack of expected impact) after only eight weeks of experiencing the medical curriculum.

3.3. Research instrument: the Inventory of Learning Styles (ILS)

The Inventory of Learning Styles (ILS) (Vermunt 1998) has been developed in the context of higher education, and – in the present study - is used to study student learning patterns. The ILS (126-item version) was adopted to the medical curriculum in cooperation with the University of Maastricht (van Luijk, Muijtjens, & Smeets 1999). Students were asked to judge on a five-point scale the degree to which the described items corresponded to their usual way of learning, their views towards or their motives for studying. A principal component analysis was used to define the factor structure of the subscales. We could distinguish 25 subscales with 107 items of the original 126. Then unreliable factors (*Cronbach alfa* $< .60$) and six factors with a too low variability were omitted. Confirmatory factor analysis of the studied factors was used to check if all parameters represent acceptable fit (Structural Equation Modelling). A cut-off value close to .06 for Root Mean Square Error of Approximation (Hu & Bentler 1998) and a Goodness-of-Fit-Index and Adjusted Goodness-of-Fit-Index (Medsker, Williams, &

Holahan 1994) of .90 are considered as critical goodness-of-fit parameters (Van der Veken et al. 2007). The final version of the instrument helps to determine three learning patterns: (1) processing strategies (*structuring*; *critical processing*; *expressing*; *use of sources of knowledge*; and *relating*); (2) regulation strategies (*self-regulation of learning content*; and *lack of regulation*); and (3) learning orientations (*vocation-orientation*; and *certificate-orientation*).

3.4. Hypotheses

Considering the theoretical base, and the way learning patterns are measured, the following hypotheses are put forward: (1) integrated contextual curriculum students will structure to a higher extent elements of the subject matter into holistic units (*structuring*) and relate more parts of the subject matter to each other and to earlier acquired knowledge (*relating*); (2) due to the introduction of tutorials and individual scientific projects, integrated contextual curriculum students will significantly increase the tendency to form personal views about study topics (*critical processing*) and consultation more and different sources of knowledge (*use of sources of knowledge*); (3) integrated contextual curriculum students are expected to be more capable of translating study content into personal phrasing or expressing (*expressing*).

Because one of the main goals of the integrated contextual curriculum was to foster self-regulation of student learning processes, we expect (1) integrated contextual curriculum students to score higher on *self-regulation of learning content*; and (2) to be less unregulated in terms of learning (*lack of regulation*).

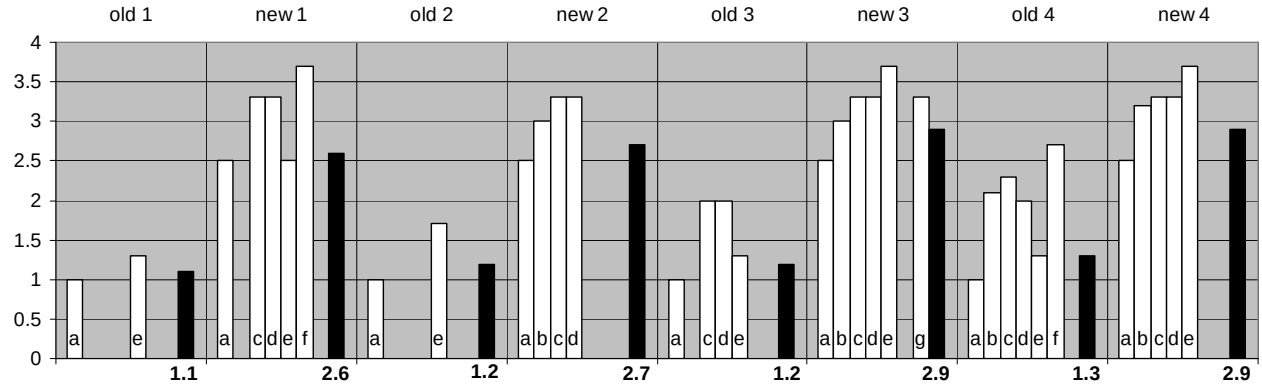
Since in the integrated contextual curriculum students are introduced into community oriented medicine, we presume that (1) this will increase the *vocation-orientation*; and the curriculum is partially vertically integrated, (2) we expect a decrease in *certificate-orientation*.

4. Results

4.1. Results about treatment fidelity

Figure 1 illustrates the SPICES-results of a comparison between both the conventional and the integrated contextual curriculum.

Figure 1



Totals in each curricular year refer to the weighted means; i.e. the sum of rates * percentage of hours scheduled for the specific type of session.

Figure 1: SPICES distribution and rating of various education sessions in conventional (old 1 – old 4) and integrated contextual (new 1 – new 4) curricular years at Ghent University.

Table 1

		YEAR 1									YEAR 2									YEAR 3									YEAR 4								
Type of curriculum	Type of educational sessions	h*	prop**	S	P	I	C	E	S	rate	h*	prop**	S	P	I	C	E	S	rate	h*	prop**	S	P	I	C	E	S	rate	h*	prop**	S	P	I	C	E	S	rate
OLD	Lectures	421	.75	1	1	1	1	1	1	1.0	386	.66	1	1	1	1	1	1	1.0	361	.58	1	1	1	1	1	1	1.0	343	.62	1	1	1	1	1	1	1.0
NEW		361	.65	1	2	4	2	1	5	2.5	318	.65	1	2	4	2	1	5	2.5	314	.56	1	2	4	2	1	5	2.5	252	.62	1	2	4	2	1	5	2.5
OLD	Clinical lectures	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	65	.12	1	3	3	4	1	1	2.1
NEW		*	*	*	*	*	*	*	*	*	74	.15	1	4	5	2	1	5	3.0	11	.02	1	4	5	2	1	5	3.0	33	.08	1	4	5	3	1	5	3.2
OLD	(PBL) small group sessions	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	76	.12	2	3	3	2	1	1	2.0	30	.05	2	3	3	4	1	1	2.3
NEW		12	.02	2	5	5	3	1	5	3.5	38	.08	2	5	5	2	1	5	3.3	35	.06	2	5	5	2	1	5	3.3	6	.01	2	5	5	2	1	5	3.3
OLD	Skills/attitude sessions	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	38	.06	2	3	3	2	1	1	2.0	15	.03	2	3	3	2	1	1	2.0
NEW		42	.08	2	4	4	4	1	5	3.3	60	.12	2	4	4	4	1	5	3.3	74	.13	2	4	4	4	1	5	3.3	60	.15	2	4	4	4	1	5	3.3
OLD	Practicals	140	.25	1	2	2	1	1	1	1.3	196	.34	1	2	2	1	1	1	1.7	143	.23	1	2	2	1	1	1	1.3	68	.12	1	2	2	1	1	1	1.3
NEW		140	.25	1	3	4	1	1	5	2.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
OLD	Community based sessions	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	30	.05	2	3	4	5	1	1	2.7
NEW		3	.01	2	4	5	5	1	5	3.7	*	*	*	*	*	*	*	*	*	39	.07	2	4	5	5	1	5	3.7	55	.14	2	4	5	5	1	5	3.7
OLD	Research hours	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
NEW		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	90	.16	2	4	5	3	1	5	3.3	*	*	*	*	*	*	*	*	*

The first theme (*student-centred vs. teacher centred*) reflects low scores because educational strategies are mainly teacher focused. But the inclusion of small group work, and skills/attitude and community oriented sessions in the new curriculum resulted in a 2-score.

Evaluation of the second theme (*problem-based vs. information gathering*) indicates that in the new curriculum and in each curriculum year, PBL was introduced as a basic format, resulting in a score of 5. As made clear in table 1, in the first year PBL-small group, skills/attitude development and community based activities raise from 0% in the conventional curriculum to 11% (combination c, d and e in table 1) in the integrated contextual curriculum. In the third year research activities rise from 0% to 16%.

In relation to the third theme (*integrated vs. discipline-based*) the integrated contextual curriculum scores very high since this curriculum consists of a sequence of integrated units focusing on knowledge, skills and attitudes from the basic, biomedical and clinical sciences. The first two and a half years of this integrated curriculum centre on the healthy normal body. The attention paid to horizontal integration results in basic science disciplines not being taught as solitary disciplines but as themes or from an organ perspective (Lie 1995). At this stage, clinical examples are introduced with plenty of real life examples. Definitions concerning vertical integration all share a focus on integrating basic domain knowledge and clinical knowledge (Koens et al. 2005;Rangachari 1997;Romeyn 1969). This means that student experience at least a partial vertical integration. In the second two and a half year cycle of the new curriculum, the same body systems are elaborated from a clinical point of view.

Evaluation of the fourth theme (*community-based vs. hospital-based*) results in high scores when considering the integrated contextual curriculum. In the first year topics of health risks are discussed. In the second year all students are confronted with the care for 'elderly and extreme care patients' and every student has to follow up a family with a newborn baby during the coming 3 years. They learn to share experiences with other professional disciplines in supporting 'challenged' city neighbourhoods. They learn to make consider diagnosis form a community perspective, and to propose solutions. During the fourth year there is shift of attention to primary health care, and the role of the general practitioner in collaboration with other health care workers. Students explore preventive health care and identify health risks and their prevention at the individual level and community level.

Evaluation of the fifth theme (*elective vs. uniform*), results in a level 1-score since all students follow the same programme. In view of the last theme (*systematic vs. apprenticeship-based*) all educational sessions of the integrated contextual curriculum aim at the final goals of the medical education with a strong focus on training for practice; this results in a high score. This is in sharp contrast with the earlier curriculum.

Following the approach of van den Berg (2004), the weighted mean was calculated for every theme, i.e. the sum of rate x percentage of hours scheduled for the specific type of session. The results reflect an overall score of 1.2 for the conventional curriculum and a score of 2.8 for the integrated contextual curriculum. The latter reflects a clearly higher SPICES-oriented profile.

Monitoring the curriculum as experienced by the students is based on an analysis of the real study load. Students report that a lot of more time was spent on 'blocks' at the expense of the longitudinal 'lines' (see table 2). The discrepancy between what was planned and what was reported by students increased from plus 11.8% in year 1 to plus 52.4% in year 4 for the 'blocks' and minus between 26.7% and 49.5% for the 'lines'. This can have influenced the expected impact of the curriculum innovation.

Table 2

	planned	real	difference	planned	real	difference
1	1170	1308	+ 11.8	630	362	- 42.5
2	1315	1530	+ 16.3	478	332	- 30.5
3	1079	1384	+ 28.3	656	481	- 26.7
4	970	1478	+ 52.4	800	404	- 49.5

4.2. Results in relation to the research question about the longitudinal impact of the curriculum innovation

4.2.1. Quality of samples

The response rate to successive administrations decreased from an initial high of .89 to a low of .76 on the final administration to students in the conventional cohort and from an initial 1.00 to .64 on the final administration to students in the integrated contextual cohort. The response rate to successive administrations during the four years decreased. Data of 57% of the subjects could be incorporated in the longitudinal analysis. This smaller sample is still representative as to educational level of parents, prior (secondary school) education, MAT-scores, progress test scores, age and gender in both curricula (see table 3). The respondents of the integrated contextual cohort score higher on the prestige-index of their parents, and differ in the extent they studied more sciences at secondary school level.

Table 3

The respondents are representative regarding to all of the nine studied ILS-scores. The integrated contextual curricular respondents are only not representative for *vocation-orientation*. Comparing participants between both curricula, integrated contextual curricular students are only different from their conventional colleagues concerning *relating* and *vocation-orientation*.

4.2.2. Impact on learning patterns

Table 4 summarizes the descriptive results and the results of the statistical analyses. The changes in three learning patterns are documented: (1) processing strategies (*structuring*; *critical processing*; *expressing*; *use of sources of knowledge*; and *relating*); (2) regulation strategies (*self-regulation of*

learning content; and *lack of regulation*); and (3) learning orientations (*vocation-orientation*; and *certificate-orientation*).

Table 4

Our expectations about the changes learning pattern in their *processing strategies* are partially confirmed when we perceive that integrated contextual curriculum students structure to a higher extent elements of the subject matter into a whole (*structuring*). In both curricula a significantly higher score can be observed for the changes in this learning pattern (small size effect), but the change pattern is clearly different in both curricula. There is no change between the 2nd and 3rd conventional curricular years and a clear change in the 4th year. The change in the integrated contextual curriculum occurs already one year earlier.

In contrast to our prediction, integrated contextual curriculum students do not relate significantly more parts of the subject matter to each other and/or to their prior knowledge (*relating*) as compared to conventional curriculum subjects. Students in both curricula reflect significantly higher scores (medium size effect).

The table also reveals an overall increase in the tendency of students in both curricula to express personal views about study topics (*critical processing*) and the capability to translate study content into personal opinions or expressions (*expressing*). The expected differential impact of introductory tutorials and individual scientific projects does not occur. In contrast, the integrated contextual curriculum students reflect a significant increase in *use of sources of knowledge* in the 4th integrated contextual curricular year. There is no such significant change in the conventional curriculum students.

In the context of the learning patterns related to *regulation strategies*, we observe a higher score (but not significantly) in the 4th integrated contextual curricular year for the learning pattern related to *self regulation of learning content*. But the integrated contextual students perform significantly better on *lack of regulation* from the 3rd year on (small effect size).

In the context of the learning pattern in the *learning orientations*, we observe, as predicted, that the integrated contextual students perform significantly different when it comes to their *certificate-orientation* (learning orientation) in the 4th curricular year (downward but not significantly). There is no change for this item in the students taking the conventional curriculum. On contrast, the *vocation-orientation* increases independent of the type of curriculum (medium effect size). The hypothesis that

introducing community oriented medicine and vertical integration would increase *vocation-orientation* is therefore not confirmed.

5. Discussion

In general, we can state that the curriculum innovation did affect learning patterns in a different way as compared to the learning patterns of students in a conventional curriculum. But there is not a general overall impact and not all the hypotheses have been confirmed.

Our findings are clearly not in line with an number of earlier studies; e.g,

- the statement that learning patterns are not expected to be influenced by the particular learning context of undergraduate education (Newble & Entwistle 1986);
- that efforts to encourage a deep and deter a surface approach did not alter in a significant way ILS-scores in a longitudinal study (Reid, Duvall, & Evans 2005); and
- the finding that academic intrinsic motivation is a rather stable construct and the opinion that it is therefore not be easy to change academic intrinsic motivation at a later stage (Gottfried, Fleming, & Gottfried 2001).

On the other hand, our results are in line with the findings of other authors(Lonka & Lindblom-Ylanne 1996;Masui & De Corte 2005;Vermetten, Vermunt, & Lodewijks 2002). These researchers report a differential impact because of changes in the design of the learning environment. In one study(Minnaert & Van der Hulst 2000) it was found that in a rather stable educational context, the intercorrelations between first and second administration of ILS are higher than in a context in which conventional teaching methods are replaced by innovative approaches.

The conflicting findings could be related to a more general debate. Some authors (McManus, Keeling, & Paice 2004) stress e.g., that personality and student learning patterns are not mere correlates of approaches to work, workplace climate, stress, burnout and satisfaction with a medical career, but rather ‘causes’ of them. Personality characteristics are therefore to rather have an indirect impact on academic achievement through the learning patterns.

The present study differs clearly from earlier studies that focused on curriculum innovations because of the longitudinal evaluation approach; e.g., the studies that focused on the expected outcomes of a PBL reorientation of the medical curriculum (Albanese & Mitchell 1993;Berkson 1993;Colliver 2000a;Colliver 2000b;Hmelo-Silver 2004;Vernon & Blake 1993). The results of these studies started a debate about the characteristics of valid evaluation approaches for curriculum innovation (Thomas 1997). A key element in these critics is the lack of longitudinal evaluation research. Also cross-sectional studies did

not show an improvement in reported quality of learning or changes in learning patterns (Busato, Prins, Elshout, & Hamaker 1998;Lonka & Lindblom-Ylanne 1996) since these are not helpful to analyse intra-individual change, and are marred by possible cohort effects. It is only in the few available attempts to set up longitudinal research that a significant impact could be found. Busato et al (1998) did e.g., detect differences in learning patterns in a longitudinal design namely an increase in reported use of a meaning-directed learning style. Also Watkins(Watkins & Hattie 1985) reported significant changes in a longitudinal study. The fact that our findings are in line with these longitudinal studies is therefore reassuring.

5.1. Impact on learning processing strategies

An earlier cross-sectional comparison of students in a conventional, PBL-like or pure PBL curriculum (Van der Veken, Valcke, Derese, & De Maeseneer 2007) did no reveal a significant change in *structuring*. But the current longitudinal evaluation approach helped to reveal earlier changes in this learning pattern (one year earlier). Also the expectation that *use of sources of knowledge* is observed significantly more in the integrated contextual curriculum has been confirmed. Both indicators of changes in learning patterns can be considered as a result of a higher adoption of a deep study approach which is in line with findings of other authors (Boyle, Duffy, & Dunleavy 2003;Busato, Prins, Elshout, & Hamaker 1998;Lindblom-Ylanne & Lonka 1999;Trigwell & Prosser 1991a;Trigwell & Prosser 1991c;Trigwell & Prosser 1991b;Vermetten, Vermunt, & Lodewijks 1999;Vermunt 1998).

But as stated earlier, not all hypotheses have been confirmed. Students in the integrated contextual curriculum did not relate more parts of the subject matter to each other and/or to their prior knowledge (*relating*); nor seemed the introduction of PBL-tutorials and the scientific projects elicite the expected impact on the capacity to translate study topics into own phrasing or *expressions*.

We can explain the fact that no significant differences were observed in *critical processing* considering the type of curriculum. The integrated contextual curriculum did not present sufficient tasks focusing on literature searches and processing; mostly exhaustive course material were prepared by the teaching staff.

5.2. Impact on learning regulation strategies

In the cross-sectional study, mentioned earlier, we were not able to detect significant changes in learning regulation strategies. In contrast, in this longitudinal design, we could detect a significant differential impact. Students in the 3rd year of the integrated contextual curriculum scored clearly lower for *lack of regulation*. Both curricula are still very comparable in the earlier curriculum years because

both the horizontal and vertical integration of the subjects only appear from the third year on. The complete vertical and horizontal integration of course content finally helps to reduce in a significant different way the *lack of regulation*. This is reconfirmed in the 4th integrated contextual curriculum year. This is in line with other research (Boyle, Duffy, & Dunleavy 2003;Busato et al. 1999;Dejong 1995;Vermetten, Lodewijks, & Vermunt 1999) and of great importance because there is evidence that *lack of regulation* is a key indicator of being unsuccessful in higher education(Minnaert 2000). The second element, related to the learning pattern in regulation strategies refers to *self-regulation of student's learning content*. The differential impact of the integrated contextual curriculum is less clear. We think that due to the low proportion of time devoted to educational strategies that build on a PBL-format, the integrated contextual curriculum did yet not fulfil its potential.

5.3. Impact on learning orientations

Second year integrated contextual curriculum students reflect a significantly higher *vocation-orientation* and evolve to a significantly higher level in the following year as compared to conventional curriculum subjects. But, this increase is not different between both curricula. We are rather surprised that although large efforts were invested in the community-orientation in the different blocks and lines, the growth itself is not different between both curricula. This could partially be explained by a percentage of the students that prefer in the end a clinical specialisation instead of a community oriented medical profession. This could also help to explain why there was not a significant larger decrease in the *certificate-orientation* in the integrated contextual curriculum. Grades are important for these students in view of getting access to the specialisation.

5.4. Directions for future research

Follow-up studies could investigate if the innovative curriculum did – next to changes in student learning patterns – also help in the actual growth and development of students in becoming expert learners. This is important since a number of other relevant research questions remain unanswered:

- is the outcome of the curriculum innovation worthwhile in terms of time and funds;
- what is the longer term impact (e.g., in terms of the professional competencies); and
- what is the impact of the curriculum change on actual knowledge acquisition and retention?

5.5. Limitations

Three limitations of the present study should be considered. The research instrument used to determine learning pattern did not reflect the actual learning behaviour, but rather student conceptions

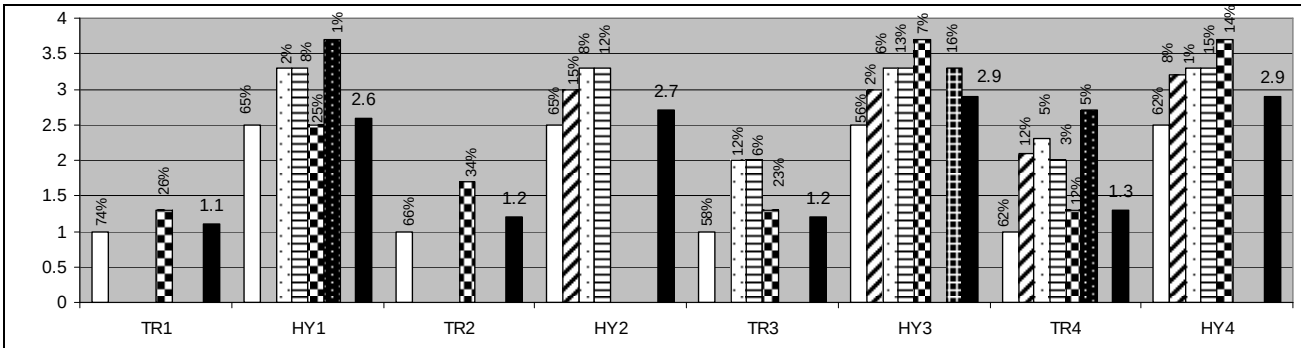
about their own learning patterns (Evans, Kirby, & Fabrigar 2003;Vermetten, Lodewijks, & Vermunt 1999). Although the use of this type of instruments is common practice in educational research, it is important to acknowledge these limitations. Since, the questionnaires were administered anonymously and we can assume that students were honest about their learning patterns, but self-reporting might still be different from actual study behaviour.

Another source of bias could be related to the consecutive repeated administration of the same research instruments. We nevertheless think that a one year interval will likely not have influenced answering patterns of students. A last limitation is related to the sample. Despite the reassuring non-response analysis, analysis results still have to be interpreted with caution when considering a generalisation to the specific student population.

6. Conclusions

Until now, most research studying the impact of curriculum innovations was restricted to short term of cross-sectional research. In the present study, a longitudinal design was adopted to study the impact of a comprehensive curriculum intervention on medical student learning patterns. This can be considered as a rather exceptional approach in the research literature. In addition, treatment fidelity was checked to compare the planned, the implemented and the experienced curriculum.

Although not all the hypotheses could be confirmed, the results suggest significant effects of the integrated contextual medical curriculum on learning processing strategies, learning regulation strategies, and on learning orientations. The clear build-up of the curriculum and the vertical and horizontal integration of subject knowledge seem to have significantly reduced the *lack of regulation* and to promote at an earlier stage in the curriculum *structuring*, *relating*, *critical processing* and the *vocational-orientation*. The effect on *use of sources of knowledge*, *self-regulation of learning content* and *certificate-orientation* appeared only in the 4th integrated contextual curriculum year and was less important as expected. It was yet not possible to confirm the hypothesis that students in the integrated contextual curriculum become better in translating study topics into their own phrasing or *expressions; and* neither the expected impact on *vocation-orientation* could be confirmed. Nevertheless, there is little doubt that the present results are important to curriculum (re)designers and those interested in the evaluation of curriculum reforms.



Percentages refer to proportion of scheduled hours.
Totals in each curricular year refer to the weighted means; i.e. the sum of rates * percentage of hours scheduled for the specific type of session.

Figure 2: SPICES distribution and rating of various education sessions in conventional (TR1 – TR4) and integrated contextual (HY1 – HY4) curricular years at Ghent University. Students starting medical education in 1998 and 1999.

Figure 1: SPICES distribution and rating of various education sessions in conventional (TR1 – TR4) and integrated contextual (HY1 – HY4) curricular years at Ghent University. Students starting medical education in 1998 and 1999.

Table 1: Comparison of the characteristics of parents, prior education, MAT-, GPA-scores, age, gender and ILS-scores of those students who filled in the questionnaires in all occasions (labelled with 'respondents') with those who cooperated only at the start of the study (labelled with 'non-respondents) and between the two cohorts participating in het longitudinal study.

Table 2: Results of longitudinal trend-analysis (year 2 to year 4) of ILS-subscales within both types of medical curriculum (General Linear Model-*ANOVA*-repeated measures).

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