Outside over Inside Analysis of Medical Students' Education Efficacy in Cognitive Domain over a given Physiology Curricula

Gliga M, Sabău M

Department of Physiology, University of Medicine and Pharmacy, Tîrgu Mureş, Romania

Aim: We tried to correlate, in cognitive domain, the second year medical students' oral evaluation results to the efficacy of education they were provided, over our medical physiology curricula between 2004 and 2011.
Material and methods: We used the fact that during the mentioned period the curricula configuration for the two semesters of the second year was identical. We also used the fact that, for a given group of students and curricula, education and evaluation were performed by the same teacher. We compared three existing and unmodified configurations: 1. different groups of students, same curricula, different teachers, 2. same group of students, different curricula, same teacher and 3. same group of students, different curricula, different teachers. We also took an inside brief evaluation of students' skills in cognitive domain at the beginning of the second year and tried to correlate it with final results.
Results: We couldn't make any correlations because of logical contradictions of the configurations we compared. We couldn't obtain, as an outside observer, concise information of what levels in cognitive domain students were evaluated on by different teachers. Merely we can say that education of the second year medical students over our physiology curricula cannot be efficient for a large amount of students who do not possess those compulsory cognitive skills that are required to study physiology.
Conclusions: The protocols used between 2004 and 2011 for evaluating medical students' skills in cognitive domain over second year medical curricula cannot give accurate information for an outside evaluator.

Keywords: cognitive domain, education efficacy, medical students, physiology curricula, oral exams

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Introduction

There is a broad preoccupation on education efficacy or effectiveness, from popular level [1], through specific topics [2] toward large international organizations [3], in all educational domains according to a generally agreed taxonomy [4]. In our physiology department medical students have always been educated in cognitive domain [5] mainly by little interactive [6] lectured courses, following a given curricula, and then students' skills in the same domain were evaluated over that curricula by an oral exam at the end of the course. Education in affective domain [7] is not a well defined item yet on our lectured courses. Education in psychomotor domain [8] is done on laboratory classes. Anyway, the final mark that medical students get at the end of curricula consists almost exclusively of the result of oral evaluation of their skills in cognitive domain only. The oral exam is performed usually by the same teacher who lectured the course. Between 2004 and 2011 and for medical students of the second year of study, physiology curricula in cognitive domain consisted for the first semester of cardiovascular and renal physiology and for the second semester of gastrointestinal, endocrine and nervous system physiology, desired and designed identically for both Romanian and Hungarian students. An outside evaluator of the education efficacy can be any stakeholder in medical students' education, beginning with leadership of our Faculty and University, then the parents, the Ministry and the whole society.

The aim of our work was to correlate, in cognitive domain, the second year medical students' oral evaluation results to the efficacy of education they were provided over our medical physiology curricula between 2004 and 2011.

Material and methods

The only traces of students' cognitive skills are their marks from their oral exams at the end of each semester. Still, an accurate outside evaluator can get more information like: physiology curricula over each of the two semesters had the same structure between 2004 and 2011, then education and evaluation in cognitive domain were performed all the time, for a given group of students and curricula, by the same teacher and finally that there were all the time two main group of students: Romanian students and Hungarian students and two curricula: first semester/winter curricula and second semester/summer curricula. We compared between 2004–2011 three existing and unmodified configurations: 1. different groups of students, same curricula, different teachers, 2. same group of students, different curricula, same teacher and finally 3. same group of students, different curricula, different teachers. Using these observed configurations we tried to demonstrate logical links between the students' results and the efficacy of education they received. We also took an inside brief evaluation of students' skills in cognitive domain at the beginning of the second medical year evaluation consisting of simple ques-

Correspondence to Mihai Gliga
Email: mihaigliga@yahoo.com

tions that can emphasize 'recall', 'understand' or 'apply' skills that are required in order to be able to study physiology. We tried to correlate this brief evaluation results with final results.

We will further have the following abbreviations: R for Romanian group, H for Hungarian group, W for first semester curricula/winter session, S for the second semester curricula/summer session and finally X, Y and Z for those 3 teachers who educated and evaluated group of students between 2004 and 2011. Consequently we have to notice that we always had, during the mentioned time interval, the following 4 groups and their associated teachers: RXW – Romanian students + X Teacher + Winter curricula, and so on HYW – Hungarian students + Y Teacher + Winter curricula, HYS – Hungarian students + Y Teacher + Summer curricula and respectively RZS – Romanian students + Z professor + Summer curricula. We considered all the time all medical students, so the numbers of students in the groups between years 2004 and 2011 were for RXW: 125, 139, 158, 177, 156, 178, 203, 217 and for HYW: 117, 119, 143, 163, 142, 184, 192, 186. There were approximately the same numbers for groups R and H in the summer session, minus occasionally withdrawn students, as it can be seen in Table V and Table VI for Total RXW compared with Total RZS and Total HYW compared with Total HYS.

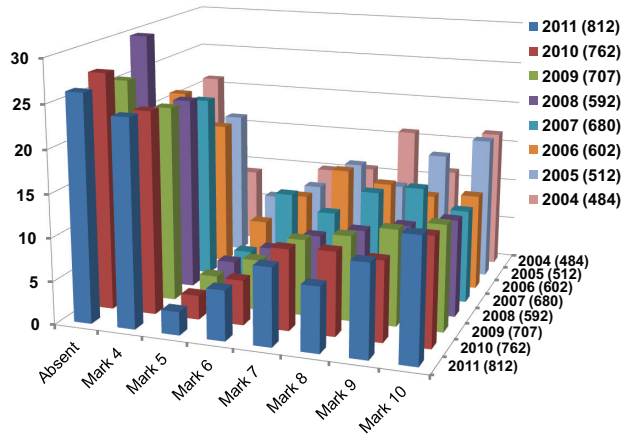

Fig. 1. % results of the oral evaluation of 5151 medical students over the year 2 Physiology Curricula between 2004–2011. Numbers in brackets represent exams (winter + summer)

Results

An overall view of our medical students' results as they were evaluated by winter and summer sessions oral exams between 2004 and 2008, is given in Figure 1. One can notice that we should have a serious preoccupation on the increasing number of unpromoted exams. The percentage of exams that students failed to pass during the same period of time in both winter and summer sessions, is presented in Table I. Distribution and differences of % exams failure

Table I. Percentage of students who failed to pass exams

5151 exam results on oral evaluation over year 2 Medical Physiology Curricula (no. Exams winter + summer)	2011 (812)	2010 (762)	2009 (707)	2008 (592)	2007 (680)	2006 (602)	2005 (512)	2004 (484)
% Exams failed (absentees + mark 4)	50%	51%	48%	53%	41%	38%	30%	30%

Table II. Distribution and differences of % exams failure over groups of students and their teachers

Year	% RXW	% HYW	% HYS	% RZS	% RXW-HYW	% HYW-HYS	% RZS-HYS	%RXW-RZS
2004	59.2	18.8	19.7	20.8	40.4	-0.9	1.1	38.4
2005	66.2	16.0	21.2	11.0	50.2	-5.2	-10.2	55.2
2006	72.8	28.7	39.2	12.0	44.1	-10.5	-27.1	60.8
2007	67.2	39.3	42.9	13.6	28.0	-3.7	-29.4	53.7
2008	75.0	54.9	55.4	25.2	20.1	-0.5	-30.2	49.8
2009	72.5	43.5	55.8	19.5	29.0	-12.3	-36.3	53.0
2010	73.9	47.9	51.6	27.6	26.0	-3.7	-24.0	46.3
2011	71.9	56.5	52.6	20.7	15.4	3.8	-31.9	51.2
8 years	**70.4**	**40.2**	**44.3**	**19.0**	**30.2**	**-4.1**	**-25.3**	**51.3**

Table III. Weighted average marks and differences of year 2 medical students groups in session exams

Year	RXW	HYW	HYS	RZS	RXW-HYW	HYW-HYS	RZS-HYS	RXW-RZS
2004	6.52	8.03	7.82	7.34	-1.51	0.21	-0.48	-0.82
2005	5.61	7.67	7.60	7.56	-2.06	0.08	-0.03	-1.95
2006	5.96	6.97	6.98	7.35	-1.01	-0.01	0.37	-1.39
2007	5.69	6.70	6.97	7.83	-1.01	-0.26	0.86	-2.14
2008	5.69	5.97	6.57	8.29	-0.29	-0.60	1.72	-2.60
2009	5.53	6.59	6.76	8.19	-1.05	-0.17	1.44	-2.66
2010	5.87	6.49	6.93	7.82	-0.62	-0.43	0.89	-1.95
2011	5.74	6.41	7.24	7.70	-0.67	-0.83	0.46	-1.96
8 years	**5.79**	**6.79**	**7.10**	**7.76**	**-1.00**	**-0.31**	**0.66**	**-1.97**

Table IV. Average comparison of 8 year failure percentages and weighted average marks between groups

Characteristics	Average comparison (T-test 2004–2011)			
	RXW/HYW	HYW/HYS	RZS/HYS	RXW/RZS
% students who failed the exam	p<0.001	p=0.59	p<0.05	p<0.001
Weighted average marks	p<0.05	p=0.39	p<0.05	p<0.001

Table V. Observed distribution of year 2 medical students who failed or passed the physiology exams

Winter 2004–2011	No. of students who failed the exam	No. of students who passed the exam	Total	Summer 2004–2011	No. of students who failed the exam	No. of students who passed the exam	Total
RXW	952	401	1353	RZS	250	1063	1313
HYW	501	745	1246	HYS	549	690	1239
Total	1453	1146	2599	Total	799	1753	2552
Chi-test: p<0.001				Chi-test: p<0.001			

Table VI. Observed distribution of year 2 medical students who failed or passed the physiology exams

H group 2004–2011	No. of students who failed the exam	No. of students who passed the exam	Total	R group 2004–2011	No. of students who failed the exam	No. of students who passed the exam	Total
HMW	501	745	1246	RXW	952	401	1353
HMS	549	690	1239	RZS	250	1063	1313
Total	1050	1435	2485	Total	1202	1464	2666
Chi-test: p=0.23				Chi-test: p<0.001			

over groups of students and their teachers are presented in Table II. Weighted average marks of same groups (without students who were absents at the exams) are presented in Table III.

Average comparison of 8 year failure percentages or weighted average marks between groups by T-student Test are shown in Table IV. Results by Chi-Test of the observed distribution of year 2 medical students who failed or passed the physiology exams are illustrated in Table V and Table VI. Both statistical tests show significant differences between groups, except between groups HYW/HYS, which is probably normal since they are practically the same students with the same teacher in two different moments in time.

The students' answer to simple questions like "Put in descendant order pressures in capillaries, arteries, veins and explain" is shown in Figure 2. Likewise, their answers to the question "Which ventricle pumps more blood" can be seen in Figure 3. These students will have formed groups of the year 2010: RXW-2010, HYW-2010, HYS-2010 and RZS-2010.

Discussions

Percentages shown in Table I can also be expressed like a failure rate and are used by a variety of Education Indicators [3, 9].

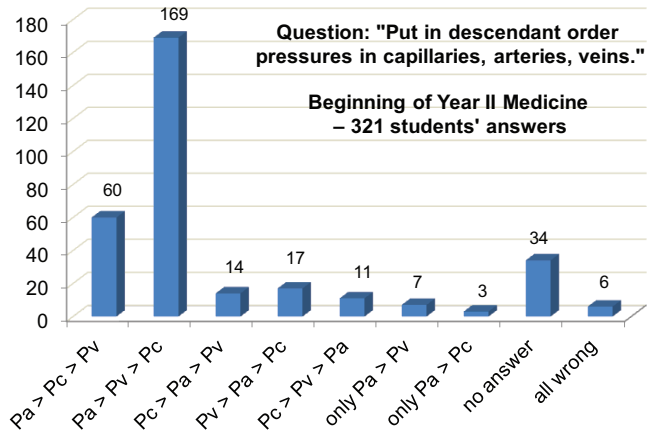

Fig. 2. The students' answer to the question "Put in descendant order pressures in capillaries, arteries, veins". Pa – arterial pressure, Pc – capillary pressure, Pv – venous pressure

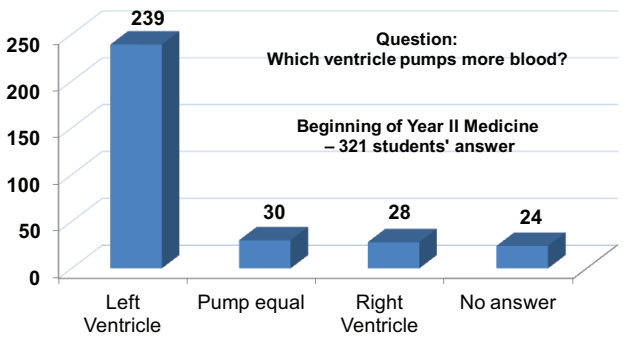

Fig. 3. The students' answer to the question "Which ventricle pumps more blood?"

Version A

One can easily notice that Romanian students have significantly worse results than Hungarian students over the same winter physiology curricula, and then the same Romanian students have significantly better results than the same Hungarian students over the summer physiology curricula. The two Hungarian groups MYW and MYS, which have been educated and evaluated in both semesters by the same teacher Y, have no significant differences in results. Since students will receive no further education after the first winter or first summer exams, whether they promoted the exam or not, one can assume that students' results at the very end of the course are correlated with the education the course provided them [10]. However, this correlation can be true only if all above mentioned 3 teachers evaluate students in quite the same manner, for example in a simplified taxonomy of cognitive domain [11] on all 3 levels 'recall of information', 'understanding', 'apply/problem solving'. Standardizing assessment is a very difficult task [12] and there are preoccupations also on an introspective professor self evaluation of own teaching protocols as well [13]. Probably it would be of benefit to start with a design of a clear set of Learning Objectives [14] to ensure that all students are well aware of what knowledge teachers are expecting from them at the end of the course, on what cognitive and detail level and how they are expected that students will demonstrate that knowledge achievement [15].

Version B

Since oral exams won't give precise information on the cognitive levels each teacher evaluated on their group of students, we can only give a hypothetical mean of the students' results. Suppose that professor X evaluated his Romanian students on the winter curricula over all 3 cognitive levels mentioned above, and professor Y evaluated his Hungarian students on both winter and summer curricula mainly on 2 cognitive levels 'recall' and 'understand' and finally that professor Z evaluated his Romanian students on summer curricula only on 'recall' level. Suppose in the end that all 4 groups of students are of same quality, which is quite reasonable, and we will still obtain the same results from Tables II, III, IV, V and VI. So we've got two possible explanations for the students' exam results: first, an 'outside' and second, an 'inside' explanation, but none of them can be certified. This is due to the lack of traceability of oral examination as a process, meaning that the mark any medical student gets after the exam is the result of the measurement of his knowledge and this result does not possess the property of traceability [16]. Traceability is a component of any Quality Management System and should be in our University as well [17]. Traceability is one of the reasons why there are institutes which are preoccupied by neutral/computerized evaluation of students [18] and why there are International Database for Enhanced Assessments & Learning builders [19].

Nevertheless, the poor cognitive skills of many of our students, as seen in Figures 1–3, pledge for the second version explanation/supposition and furthermore may eventually rise up new approaches on teaching biological sciences in general and of course physiology [20,21]. Using concepts like Human Cognitive System Architecture [22] or the computer aided concept we developed recently [23] can also be useful. Anyway, evaluating the quality of students' education via oral exams is an uncontrollable setup, meaning that evaluating in this way your own educational performances can be a wheel that rotates, but leads nowhere or anywhere.

Conclusions

The protocols/oral exams, used between 2004 and 2011 for evaluating medical students' skills in cognitive domain over second year medical physiology curricula, cannot give accurate information for an outside evaluator of education efficacy. Also, an inside point of view is irrelevant, since proper information cannot be retrieved due to lack of traceability of oral exams. Still, students' evaluation results are as they are and we could not make, due to logical inconsistencies, any correlation in cognitive domain between the second year medical students' oral evaluation results and the efficacy of education they were provided over our medical physiology curricula between 2004 and 2011. Yet, the leadership of our University decided to replace since now on the oral exams with written exams and this can be of benefit for education efficacy too.

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