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Test as a tool for interim assessment of medical students in teaching human physiology

ABSTRACT

Control and assessment are immanent parts of process of education. It is evident that regular control is one of the main factors that influence students' learning results. In the context of teaching medicine this is crucially important from the viewpoint of social effects. Knowledge of human physiology is a key prerequisite for effective learning process in a plenty of clinical disciplines and medical practices. Therefore control and assessment in teaching human physiology are essential components of effective management and adaptation of the educational process in meeting students' needs. In the report is presented an idea for organizing and implementing control and assessment as inseparable part of educational process in human physiology as a preclinical discipline for medical students. A test as a part of interim assessment on theme of electrocardiography (ECG, EKG) in human physiology practices is described. The test is applied in two equivalent types insuring implement objectivity. A connection between students' answers on related tasks is a base to analyze test reliability. Degrees of difficulty and discrimination index are commented for multiple-choice tasks. Summative test results are illuminated in field of formative assessment and effective managing educational process.

Key words: test, interim assessment, medical education, human physiology

Introduction

Control and assessment are immanent parts of process of education. It is evident that regular control is one of the main factors that influence students' learning results. In the context of teaching medicine this is crucially important from the viewpoint of social effects. Knowledge of human physiology is a key prerequisite for effective learning process in a plenty of clinical disciplines and medical practices. Therefore control and assessment (dominantly interim and formative) in teaching human physiology are essential components of effective management and adaptation of the educational process in meeting students' needs.

"Interim assessment is the term for the assessments that fall between formative and summative assessment, including the medium-scale, medium-cycle assessments currently in wide use. Interim assessments evaluate students' knowledge and skills relative to a specific set of academic goals, typically within a limited time frame, and are designed to inform decisions at both the classroom and beyond the classroom level" (Perie et al., 2007).
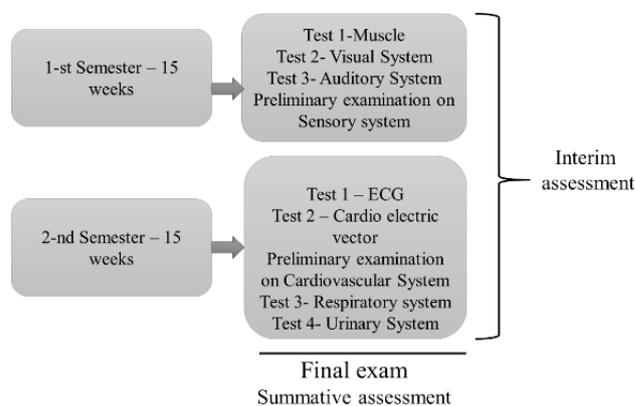

Figure 1. *Integration assessment types in physiology education*

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Effective assessment, dedicated to improve students' results, requires combination of different assessment types. We suggest an idea for organizing and implementing control and assessment as inseparable part of educational process (Figure 1).

In medical education, the field of study of physiology continues to play a central role in the curriculum, regardless of the learning styles adopted. In clinical practice, an understanding of human function is an integral part of the evaluation of a clinical case.
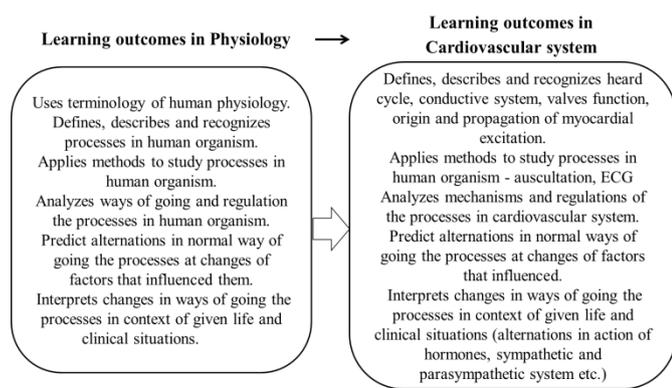

Figure 2. *Relationship between learning outcomes in physiology and in cardiovascular system*

Physiology of cardiovascular system is an essential part of medical students learning. It is well known that cardiovascular disorders are first-place contributor for the lethality among population of developed countries. That is why cardiac physiology receives much attention in the curriculum of all medical specialties and particularly in those for medical doctors. In this context electrocardiography (ECG or EKG) plays a very important role as a fundamental diagnostic method of heart electrical activity bridging gaps between heart's basic physiology, fundamental electrocardiographical concepts and clinics. ECG is taught extensively for medical students through lectures and practical demonstrations on healthy volunteers. Students develop basic practical skills and theoretical knowledge in electrocardiography (e.g. how and where to place electrodes, how to tell heart cycle duration and heart rate from ECG record etc.). The use of healthy human subjects in ECG exercises has several key advantages: students typically relate well to their own bodies, tend to be quite interested in how their bodies work, and data collection is straightforward.

Taking into account the importance ECG technique in elucidation of heart physiology and its clinical significance as a powerful diagnostic tool it is obvious the key place which ECG occupies in training of medical students. Process of teaching and learning physiology is based on meeting medical education instructional targets that influences each theme of curriculum including cardiovascular system (Figure 2).

Materials and Methods

The test consists of twelve tasks including ten of multiple-choice type and two tasks with short free answer.

Tasks are related with defined cognitive levels and learning aims (Table 1).

The commented relationship between task and educational aims is connected with test validity. The test is applied in two equivalent variants insuring implement objectivity. The equivalence is studied by one-way ANOVA followed by Newman-Keuls post hoc test. Test reliability (Cronbah alpha), degrees of difficulty and discrimination index are analyzed.

Results

We have researched following hypotheses, related on described test:

• Test variants 1 and 2 are equivalent, which means that there is no significant difference between examination marks of two test forms.

• The test has acceptable reliability.

• Test results reveals problem topics in students learning

We have compared two test variants by Mean examination marks and their respective standard deviations (SD). Results show no significant differences between two variants. (Table 2, Table 3, Figure 3).

We have analyzed tasks degree of difficulty and discrimination index and we found that all of tasks are easy (degree of difficulty between 0.877 – 0.503) and with low discrimination index (0.182 – 0.636) (Table 4). Established Cronbach alpha about test reliability (both variants 1 and 2) is 0.605. Although such result is not up than 0.8, it is acceptable in order to interim, not summative assessment test purpose (Cronbach & Shavelson, 2004; Tafrova, 2007). We can improve reliability with increasing amount of test tasks.

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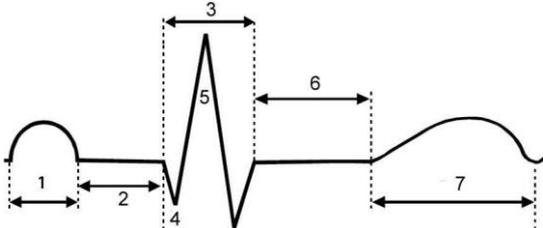**Table 1**. *Cognitive level, amount and task type description*

Cognitive level	Learning aims	Amount of tasks and type	Task-example
Knowledge	Term and define Einthoven leads	5 – multiple choice	Task 3. Lead II by Einthoven is between: A. Right arm and left leg B. Right arm and right leg C. Right arm and left arm D. Left arm and right leg E. Right leg and left leg
Comprehension	Recognize ECG elements	4 (2 – multiple choice; 2 – short free answer)	Task 11: Name the components of normal electrocardiogram on figure.
Application	Calculate and connects applying dependencies in EKG	3 – multiple choice	Task 8: In standard electrocardiogram voltage of 1 mV must correspond to deflection of recorder's pen by: A. 0,01 mm; B. 0,1 mm; C. 1 mm; D. 10 mm. E. 15 mm

Table 2. *Mean examination marks and respective SD related with two test variants*

	Variant 1	Variant 2	Variant 1 SD	Variant 2 SD
Group examination mark	8.345	7.409	1.895	1.992
Strong group examination mark	9.727	9.333	0.467	0.816
Weak group examination mark	6.545	5.143	1.864	0.69

Table 3. *Test variants 1 and 2 description by "Strong" groups and "Weak" groups SD, N and average*

	Average student ball	Standard deviation	N
Variant 1	8.345	1.895	29
Variant 1 Bottom 27%	6.545	1.864	11
Variant 1 top 27%	9.727	0.467	11
Variant 2	7.409	1.992	22
Variant 2 Bottom 27%	5.143	0.69	7
Variant 2 top 27%	9.333	0.816	6

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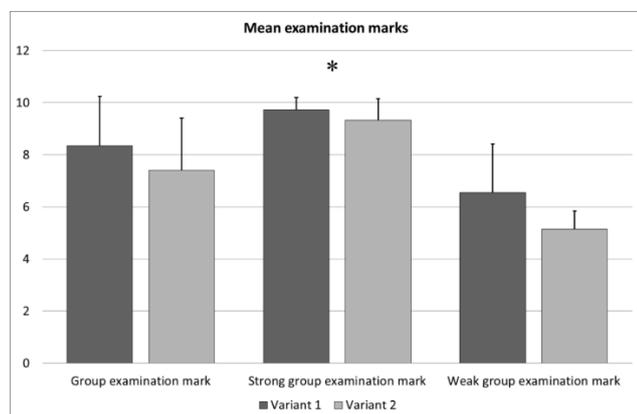
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Figure 3. *Mean examination marks of students from both variants of the test and their respective strong and weak subgroups. Error bars represent standard deviation of each group. Asterisk indicates both strong groups of two variants of the test which differ significantly from all other group (p<0.05 , one way ANOVA with Newman-Keuls post hoc test, N>6 for each group). There are no significant differences between mean examination marks of variant 1 and variant 2 of the test in three groups.*

Table 4. *Tasks degree of difficulty and discrimination index*

Task	Degree of difficulty	Discrimination index
Task 1	0,837	0,182
Task 2	0,678	0,364
Task 3	0,701	0,273
Task 4	0,682	0,636
Task 5	0,877	0,182
Task 6	0,801	0,182
Task 7	0,732	0,273
Task 8	0,823	0,091
Task 9	0,687	0,636
Task 10	0,702	0,364
Task 11.1	0,809	0,455
Task 11.2	0,503	0,545
Task 11.3	0,823	0,364
Task 11.4	0,716	0,364
Task 11.5	0,701	0,364
Task 11.6	0,664	0,545
Task 11.7	0,610	0,636
Task 12	0,591	0,455

In reference to degree of difficulty and discrimination index it is reasonable to suppose that these results are acceptable in field of correlation between learning outcomes and tasks related with test validity too (Table 1).

Discussion

Qualitative and quantitative analysis is based on principles of formative assessment. The main purpose of test results is to inform both the educator and the students about what is important to know and the students' progress toward reaching learning outcomes. Formative assessment is directed to transformation in way of teaching and learning (Enger & Yager, 2009).

Taking into account results it is evident that most of students are able to term and define Einthoven leads and to calculate applying dependences in ECG. Students meet difficulties in short free answers due to memorizing terms (most difficult in described test is PQ-segment - task 11.2). This is the reason to use multiple-choice integrated with short answer type tasks. Multiple choice is related with recognizing right term, while short answer tasks demand on memorizing. Recognizing among given opportunities is a good prerequisite for memorizing. Getting over such type of difficulties educator makes learning situations that require using terminology. Tests we applied in context of interim assessment shows that there is no correlation between degree of difficulty and task cognitive level (Kibble & Johnson, 2011). In the context of discussed test we suppose that there is correlation between task difficulty and type of examination situation. Tasks related with absolutely structured situation are less difficult than tasks that are related with student's domination in structuring situation.

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