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).
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.

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 (Cronbach 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.
Table 1. Cognitive level, amount and task type description

<table>
<thead>
<tr>
<th>Cognitive level</th>
<th>Learning aims</th>
<th>Amount of tasks and type</th>
<th>Task-example</th>
</tr>
</thead>
</table>
| **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

<table>
<thead>
<tr>
<th></th>
<th>Variant 1</th>
<th>Variant 2</th>
<th>Variant 1 SD</th>
<th>Variant 2 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group examination mark</td>
<td>8.345</td>
<td>7.409</td>
<td>1.895</td>
<td>1.992</td>
</tr>
<tr>
<td>Strong group examination mark</td>
<td>9.727</td>
<td>9.333</td>
<td>0.467</td>
<td>0.816</td>
</tr>
<tr>
<td>Weak group examination mark</td>
<td>6.545</td>
<td>5.143</td>
<td>1.864</td>
<td>0.69</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Average student ball</th>
<th>Standard deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant 1</td>
<td>8.345</td>
<td>1.895</td>
<td>29</td>
</tr>
<tr>
<td>Variant 1 Bottom 27%</td>
<td>6.545</td>
<td>1.864</td>
<td>11</td>
</tr>
<tr>
<td>Variant 1 top 27%</td>
<td>9.727</td>
<td>0.467</td>
<td>11</td>
</tr>
<tr>
<td>Variant 2</td>
<td>7.409</td>
<td>1.992</td>
<td>22</td>
</tr>
<tr>
<td>Variant 2 Bottom 27%</td>
<td>5.143</td>
<td>0.69</td>
<td>7</td>
</tr>
<tr>
<td>Variant 2 top 27%</td>
<td>9.333</td>
<td>0.816</td>
<td>6</td>
</tr>
</tbody>
</table>
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.

References

Tafrova A. 2007. Making tests – applied in chemistry education, Pedagog 6 (in Bulgarian)