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Test in the context of formative assessment in teaching of methodology of biology education

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ABSTRACT

Methodology of biology education is a basic science and key discipline in the process of biology teacher training. Educational standards in biology teacher training are among methodology of biology education subjects of scientific research. Standards for biology teacher training in methodology of biology education as a discipline are reflection of its scientific purposes. Effective managing of educational process requires regular control and assessment based on standards as criteria for educational quality measuring. Results are source of information how to correct and adapt teaching and learning in order to reach defined standards.

Test applied in studying methodology of biology education as discipline is presented in the current report. The test is for achievements, defined time, individual, diagnostic, formative and based on standards. Self-assessment is concomitant section of each one of tasks in the test presented with choice own answer certainty among given opportunities: absolutely answer certain, partly answer certain and answer uncertain.

Results are quantitative analyzed in SPSS by mean, SE, SD and correlative analysis (Spearman-Brown's coefficient) between assessment and self-assessment.

Key words: test, teacher training, formative assessment, self-assessment

Introduction

Profession is a term to name content of human working activity that influences society development. Teaching as a trade affects society for a long periods of time. Therefore quality of teacher training is a subject of permanent interest. Measuring quality of education is absolutely necessary to have stable criteria as educational standards to compare with (Boiadjeva, 2010; Tafrova-Grigorova, 2011; Tafrova-Grigorova et al., 2012).

Methodology of biology education (MBE) is a basic science and key discipline in the process of biology teacher training. Educational standards not only in teaching biology but in biology teacher training are among methodology of biology education subjects of scientific research.

Standards for biology teacher training in methodology of biology education as a discipline are reflection of its

scientific purposes (Figure 1).

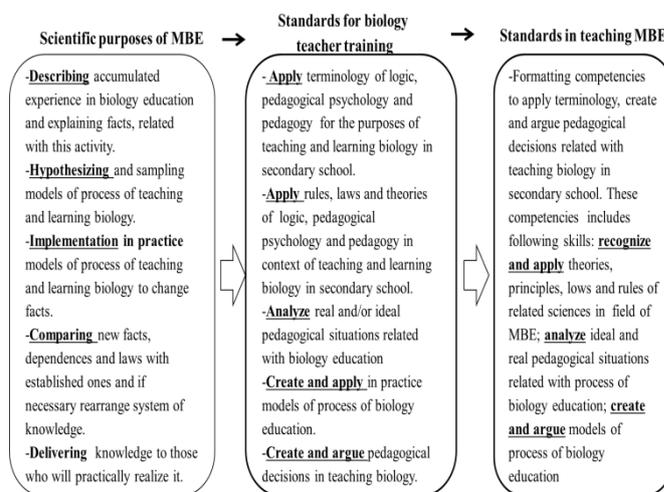


Figure 1. Relationships among scientific purposes, standards for biology teacher training and standards in teaching MBE.

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Structural elements of standards are created in context of European Qualifications Framework (Implementation of “Education and Training 2010” Work Programme, 2004). Key elements in standards are skills with included in their composition knowledge and features of situation (Figure 2).

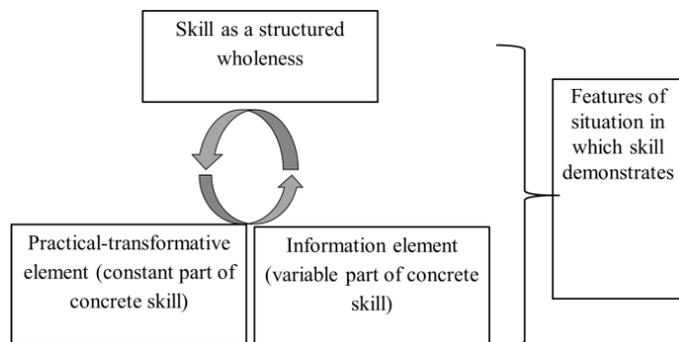


Figure 2. Theoretical framework to create standards in teaching and learning MBE.

Effective managing of educational process requires regular control and assessment based on standards as criteria for educational quality measuring (Gospodinov *et al.*, 2008). Results are source of information how to correct and adapt teaching and learning in order to reach defined standards (Black & Wiliam, 1999; Duschl & Gitomer, 1997; Sadler, 1989).

Materials and Methods

Our idea is the scientific understanding of the essential features, the operational structure and ways of formative assessment to be transformed into tools, in particular in didactic tests. We plan that they will perform both formational and diagnostic functions in teaching MBE. We assume that both functions (assessment and self- assessment) (Slavin, 2004) can be successfully implemented if the didactic tests consist of specialized tasks and if a “self-assessment close” (end) is added to them. These tasks should be designed in such a way that to shape actions of students' reflection over their knowledge (Vasilev, 2006).

Test can function as effective means of assessment and self-assessment in learning of MBE, has been verified with a statistical survey. It aims to verify the developed means for their reliability, in order to make well-founded decisions that concern the application of the tests in the teaching practice in MBE.

The main method applied in this research is a test as a method of pedagogical diagnosis. Test applied in studying methodology of biology education as discipline could be described according to several features (Table 1) (Bizhkov, 1992).

Table 1. Type of test described with several features.

According to aims of measuring	For achievements
According to duration	For defined time
According to way of implement	Individual
According to type of answer	Written
According to purposes	Diagnostic/Formative
According to assessing	Based on standards

The test contains fifty tasks in two main groups – tasks with structured answer and tasks with free answer. Twenty-two of tasks with structured answer are multiple-choice type and eight are correspondence type. Ten tasks require short free answer and nine are long free answer type. Tasks are related with three main cognitive levels described with specified skills – reproductive, productive and creative (Figure 3) (Gospodinov *et al.*, 2008).

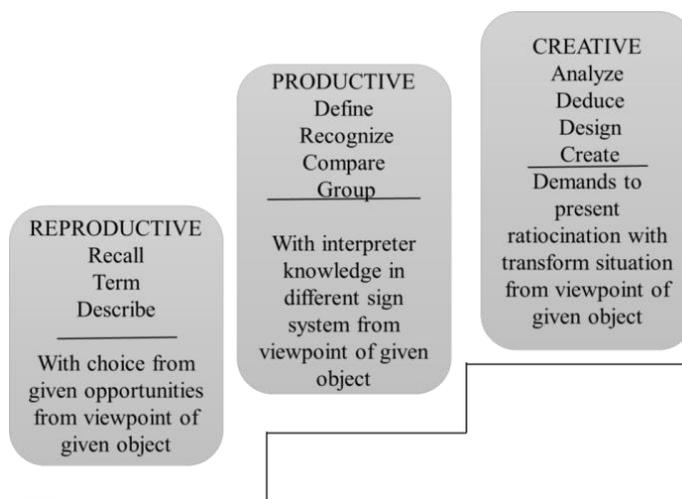


Figure 3. Cognitive levels and their description with skills and features of situation.

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Each task is under assessment by examiner and self-assessment by student. Self-assessment is concomitant section of each one of tasks in appropriation stage of answer certainty. Student should choose own answer certainty among given opportunities: absolutely answer certain, partly answer certain and answer uncertain.

An illustration of cognitive levels with appropriate tasks is shown below:

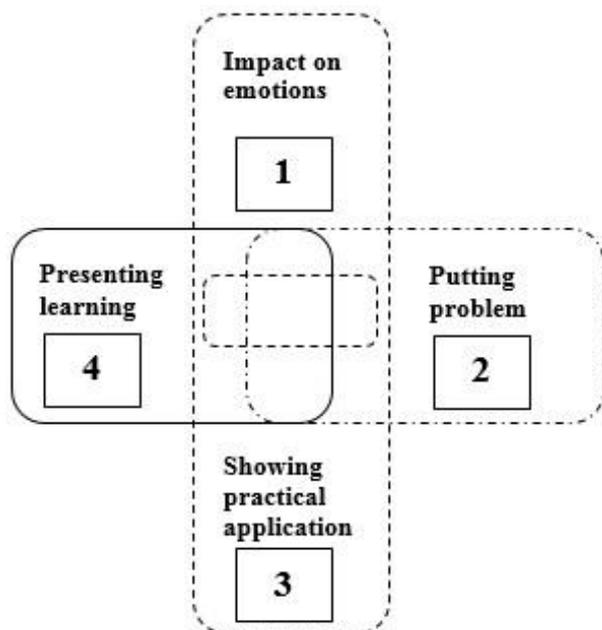
REPRODUCTIVE

Logical disjunction is related with coordinating conjunction:

- A) AND among all of notion features;
- B) AND among some of notion features;
- C) OR among all of notion features;
- D) OR among some of notion features

PRODUCTIVE

Four ways to motivate students are given on scheme. Choose correct statement, related with scheme



- A. Ways 1, 2, 3 and 4 should be applied just separately;
- B. Ways 1, 2, 3 and 4 should be applied just together;
- C. Ways 1 and 3 should be applied just together;
- D. Ways 2 and 4 should be applied together.

CREATIVE

View with Euler diagram relationship that shows:

Notion A entirely comprises notion B
and

Natural features of notion A are features of notion B too.

Give an example with biology notions to illustrate this relationship.

Test-specification is presented on Table 2. Twenty-three of tasks (46%) are related to reproductive level which requires recall, term and describe with choice from given opportunities from viewpoint of given object. Twenty-two of tasks (44%) are related to productive level – define, recognize, compare and group with interpreter knowledge in different sign system from viewpoint of given object. Solely 5 tasks (10%) are related to creative level – analyze, deduce, design and create demands to present ratiocination with transform situation from viewpoint of given object.

The results of statistical processing of empirical data were performed with the program SPSS 13.00. Results are quantitative analyzed in SPSS by Mean, SE, SD and Correlative analysis (Spearman–Brown’s coefficient) between assessment and self-assessment (Bizhkov, 1992; Manov, 2001).

Results

The research puts on following questions:

- What kind of relations between assessment and self-assessment exists?
- Where are misunderstandings in learning MBE?
- Does the test have acceptable reliability?

Results shows that students have answer certainty in reproductive level tasks and reasonable highest exam marks on it. Lower level of answer certainty is detected on productive level tasks. The main misunderstanding is in creative level tasks – lowest exam marks and relatively higher answer certainty (Table 3).

Students’ achievement is satisfactory marked with Mean 32.79 in upper 100 points. Reliability of the test (noted with the term “split-half reliability”) was measured by the Spearman – Brown’s coefficient r_{sb} , which is preferable for testing of linear correlation between the raw scores of test items divided into two halves. The coefficient of correlation r_{sb} is in 0.728 (for $\alpha=0.01$, $p < 0.01$), which describes the strong dependence between the results of the two halves of test and thus demonstrate very good reliability (Table 4).

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Table 2. *Test-specification.*

Themes of curriculum	Amount of tasks / %	Cognitive level/ task type
Professional pattern of biology teacher	1 (2%)	Reproductive multiple choice
Methodology of Biology Education as a science	2 (4%)	Productive: short free answer – 1 long free answer - 1
Biology learning objectives	11 (22%)	Reproductive – 9 (multiple choice) Productive – 2 (correspondence type)
Selection and structure of biology curriculum	11 (22%)	Reproductive – 3 (multiple choice) Productive – 5 (1 – correspondence type, 4 – short free answer) Creative – 3 (long free answer)
Process of Education:		
- System Analysis	3 (6%)	Productive (1 – correspondence type; 1 – short free answer; 1 – long free answer)
- Organization in Process of biology education	6 (12%)	Reproductive -2 (multiple choice) Productive – 3 (1 correspondence type; 1 – short free answer; 1 – long free answer) Creative – 1 (long free answer)
- Methods of Education	6 (12%)	Reproductive – 2 (multiple choice) Productive – 3 (1 – correspondence type, 1 – short free answer, 1 – long free answer) Creative – 1 (long free answer)
- Students Motivation in Process of biology education	2 (4%)	Reproductive – multiple choice
- Algorithms in Process of biology education	1 (2%)	Reproductive – multiple choice
- Learning and Cognitive Tasks in Process of biology education	3 (6%)	Reproductive – 1 multiple choice Productive – 2 (1- correspondence type; 1 -short free answer)
Learning Theories	4 (8%)	Reproductive – 2 - multiple choice Productive – 2 (1 – correspondence type; 1 short free answer)
Total	50 (100%)	

Table 3. *Assessment and self-assessment results of different cognitive levels tasks.*

	Correct answer (%)	Absolutely certain (%)	Partly certain (%)	Uncertain (%)
Reproductive tasks	66.70	86.60	3.40	10.00
Productive tasks	40.00	23.30	53.40	23.30
Creative tasks	36.70	66.60	16.70	16.70

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Table 4. *Statistical variables.*

	Statistical variables				Spearman– Brown’s coefficient r_{sb}
	N	Mean	SE	SD	
assessment		32.790	0.052	0.302	Correlation Coefficient = (0.728**) $p < 0.01$
self- assessment	30	43.200	0.049	0.268	

The comparison between answer correctness and answer certainty shows high level of correlation between correct and absolutely answer certain marks and middle-level correlation between correct and partly answer certain marks. Most strong correlation was observed between the correct – absolutely answer certain ($f=712$), $r_{sb}=0.813$ ($p < 0.01$), and the lowest between wrong – answer uncertain ($f=295$), $r_{sb}=0.107$ ($p=0.343$; $p > 0.01$). Moderately correlation exists between the correct – partly answer certain ($f=258$), $r_{sb}=0.312$ ($p=0.052$; $p > 0.01$) (Table 5).

Table 5. *Correlation between assessment and self-assessment.*

	Spearman – Brown’s coefficient r_{sb}
Correct – absolutely answer certain ($f=712$)	Correlation Coefficient = (0.813**) $p < 0.01$
Correct – partly answer certain ($f=258$)	Correlation Coefficient = (0.312) $p=0.052$; $p > 0.01$
Correct – answer uncertain ($f=44$)	Correlation Coefficient = (0.163) $p=0.078$; $p > 0.01$
Wrong – absolutely answer certain ($f=111$)	Correlation Coefficient = (0.194) $p=0.084$; $p > 0.01$
Wrong – partly answer certain ($f=80$)	Correlation Coefficient = (0.157) $p=0.112$; $p > 0.01$
Wrong – answer uncertain ($f=295$)	Correlation Coefficient = (0.107) $p=0.343$; $p > 0.01$

Discussion

Result analysis is based on concept for assessment as a “feedback system to inform teachers about effectiveness of instruction and to inform students about how well they are learning” (Enger, 2009).

In the test is not included all of curriculum, because it is implemented before finishing studying discipline. In such type of situation educator and students have enough time to correct the process and reach educational standards before final exam.

Qualitative analysis is based on principles of formative assessment. The main purpose of test results is to inform both the educator and the students about progress toward meeting educational standards. Students have difficulties in creative tasks, that’s why there were carrying out additional exercises dedicated on generation and argue ideas related with different kinds of pedagogical situation in teaching biology.

Own tests in giving back were attended by individual information about difference between wrong answers and correct answer, more examples to illustrate correct understandings and individual tasks to solve.

Students that pass the test show extremely high final result than the rest. In order to improve educational quality in teaching key professional discipline as Methodology of Biology Education the described diagnostic and formative test has been transformed from optional to obligatory one.

Presented research confirms primary role of regular control, formative assessment and conscious students taking part in assessment in enhance educational quality at all.

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