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CONTRIBUTION TO PEDAGOGICAL DIAGNOSTICS IN TEACHING FOCUSED ON HEALTH AND SAFETY AT WORK FOR TEACHERS OF NATURALIST AND TECHNICAL SUBJECTS

1. Introduction

Questions about didactic tests focusing on the selected problems health and safety issues for teachers of naturalist subjects are very discussed topic today. Particular problems of the topic are creation and using the tests as form of investigation of knowledge and skills level of students as well as objectivity and reliability of the tests[1].

The test represents an exam with the same conditions for all tested persons and with quantitative character of their results. The didactic test is a special kind of test for evaluation of results in educational process.

2 Development of a Didactic Test

The development of a didactic test may be split into basic stages:

- planning of a didactic test,
- designing a didactic test,
- validation of a didactic test.

[1] Melezinek A.(1986) *Ingenieurpädagogik*: Praxis der Vermittlung technische Wissens techn. Wissens. Wien, New York, Springer, 1986; TUREK, Ivan (2014): *Didaktika*, Bratislava, Wolters Kluwer 2017, ISBN: 978-80-8168-004-5.

2.1 Planning of Didactic Test

One of the basic requirements imposed upon a good didactic test is that a didactic test should ensure uniform, representative coverage of the knowledge being verified, i.e. to ensure maximum content validity of the didactic test. The educational practice offers several techniques to specify the contents of a didactic test. In their practice, the teachers use both techniques - the specification table technique (see Table I. part *2.1.1*) and the specific target list technique (see Table II. part *2.1.2).*

2.1.1 Specification Table Technique (in DT planning)

The specification table technique is especially suitable for planning of baseline and final didactic tests (with greater temporal and thematic extent of curriculum testing).

The development of a specification table consists of three steps:

a) definition of the structure of the curriculum to be tested,
b) definition of the number of tasks in the didactic test,
c) definition of the level of knowledge that the tasks aim to verify.

Re a) definition of the structure of the curriculum to be tested - The first step in development of the specification table involves the specification of the curriculum units (column 2) associated with the number of lessons used to cover the specific curriculum unit (column 3). In case of self-learning number of pages in textbook devoted to individual thematic units can be recommended instead of the number of lessons. The absolute numbers (number of hours) in column 3 are converted to percentage in column 4.

Table I. Specifications Table Technique (in DT planning)

o. of thematic unit	Curriculum units (thematic units)	Number of lessons		Number of tasks focused on			Total number of tasks			
		absol.	rel. %	R - remembering	U - understanding	TrD+TrN - application (direct and indirect transfer)	Preliminary		Final	
							absol.	rel. %	absol.	rel. %
1	I. Safety of work on electrical equipment	9	31,04	3	2	1		31	4	28.57
2	II.Three-phase system	9	31,03	3	2	1		31	4	28.57
3	III. Generation, transmission and distribution of electric power.	11	37,93	1	3	5		38	6	42.86
	TOTAL	29	100	7	7	7	14	100	14	100

Re b) The second step is to determine the number of tasks in the didactic test. The number of tasks is determined by a series of circumstances. Primarily it is the requirement for high reliability and accuracy, i.e. test reliability. As the reliability of the test increases with the number of tasks, it is necessary for the didactic test to contain the highest number of tasks. Ten tasks are considered the minimum limit. The maximum limit of the number of tasks in the didactic test is determined by the age specifics of the persons being educated.

Re c) The specification table defines the level of knowledge to be tested by individual tasks. A good didactic test should not contain only tasks aimed at remembering the knowledge, but also at understanding and application of the knowledge. When considering the level of knowledge that the tasks are aimed at testing, the taxonomies of educational objectives are of great benefit (e.g. Bloom, Tollinger, Niemierko, etc.)

The requirements applicable upon the knowledge of the individual being educated in the field focusing on the selected problems Health and Safety Issues for teachers of naturalist subjects are best satisfied by the classification of the tasks based on Niemerko´s taxonomy of education objectives. When formulating the educational objectives, we use active verbs,

i.e. verbs that represent observable activity. B. Niemierko recognizes 4 levels of educational objectives, specifically[2]:

- **a)** Remembering information (knowledge),
- **b)** Understanding the information (knowledge),
- **c)** Application of information (application of knowledge) in typical situations - solving typical school tasks - specific transfer
- **d)** Application of the information (knowledge) in problem situations - non-specific transfer.

Re a) At this level, the student is required to recall, recognize, reproduce the terms, facts, words, relationships, acts, principles of activities, procedures, etc., i.e. memory reproduction of the curriculum elements. Typical active verbs used at this level to express the actions by the students are: list, write, define, repeat, name, draw, etc.
Re b) The student is able to present the remembered knowledge (information) in a form different from the one he/she remembered, with ability to make it brief, interpret the content using his/her own words, etc. Typical active verbs: explain, translate, express in a different way, clarify, express in your own words, recognize, list examples, describe activities, etc.
Re c). The student is able to apply the acquired knowledge according to the presented template, addressing similar tasks to those solved previously by the teacher or those in the textbook, workbook, etc. Typical active verbs: search, resolve, apply, draw schematically, test, decide, classify, etc.
Re d.) The student is able to formulate the problems, perform analysis, synthesis of new phenomena, formulate the sequence of activities, solve problematic tasks, etc. Typical active verbs: suggest, derive conclusions, defend, construct, assess, etc.[3].

The developer of the didactic test may leave out or join some learning levels.

Through application of Niemierko´s theory upon the learning levels in the field of didactic tests focusing on the selected problems Health and Safety Issues for teachers of naturalist subjects, the following types of tasks can be designed:

- **a)** memory tasks – reproductive,
- **b)** tasks verifying the understanding (comprehension) of knowledge,
- **c)** tasks aimed at the application of knowledge in typical school situations - specific transfer,
- **d)** tasks for application of knowledge in problem situations mainly in practice - non-specific transfer

[2] Bernát, M.(2015): *Visualization of some electro-physical process through computer for didactic purposes and its application in teaching electrotechnical subjects*. PhD. Thesis, PdF UKF Nitra 2015; Melezinek A. (1986) *Ingenieurpädagogik*: Praxis der Vermittlung technische Wissens techn. Wissens. Wien, New York, Springer, 1986; Turek, Ivan (2014): *Didaktika*, Bratislava, Wolters Kluwer 2017, ISBN: 978-80-8168-004-5 .
[3] Turek, Ivan (2014): *Didaktika*, Bratislava, Wolters Kluwer 2017, ISBN: 978-80-8168-004-5 .

Re a) memory tasks - reproductive

With respect to activation, these represent didactically least effective type of test tasks. However, they fulfil an essential role regarding the purpose, such as inquiry or verification questions. Through memory tasks the teacher is able to verify the current level of knowledge and skills. E.g.

T1. *Draw a graphic symbol (letter) identifying neutral conductor terminal.*
T2. *List the methods of protection against direct contact*

Re b) tasks verifying the understanding (comprehension) of knowledge

These are targeted at the memory component of the concept-creation process as well as at the use of elementary cognitive operations, especially analysis-synthesis, induction - deduction, comparison and generalization. Using thus focused tasks, the student is searching for links between the current and previously learned terms, as well as the causal relationships between them. The teacher uses this type of tasks in order to associate the learning of facts with comprehension of the relationships between them. These tasks include:
T3. *Explain the concept of three-phase AC system.*
T4. *Explain the meaning of digits in IP XY designation,*
T5. *Figure 1 depicts the basic components of the circuit in residential installation, with the schematic (functional diagram) to be completed. The circuit is characteristic by the fact that it is used to control (independently turning on/off) of a light bulb (lamp) from three different (remote) locations. (+, B, U).*

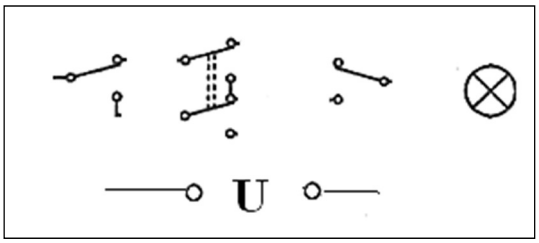

Figure 1. Created by M. Bernát

Re c) tasks aimed at the application of knowledge in typical school situations - specific transfer

T6. *Figure 2 shows an incomplete schematic. The circuit is characteristic by the fact that both light bulbs (lamps) can be controlled independently. (+, B, TrD) (complete the drawing and colour-code the phase, neutral and protective. use colour pencil).*

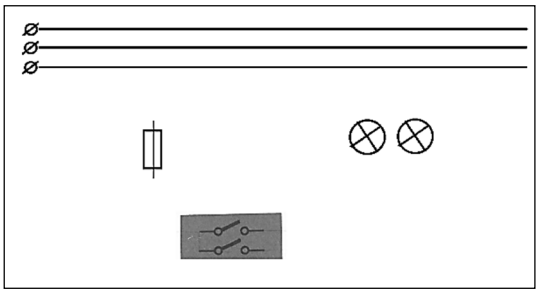

Figure 2. Created by M. Bernát

The student is able to apply knowledge based on the presented template (we ask for knowledge in similar situations as it those previously made available), solve tasks similar to those previously solved or as mentioned in the textbook.

T7. *Propose algorithmic schematic procedure for indirect heart massage and CPR. (+, B, TrD).*
T8. *Describe types of protection against electric shock.*
T9. *Imagine that we want to design the electrical wiring for lighting of a "long room". We want to control the bulb from two places (at the beginning and end of the room), so that we want to be able to turn it off and off anywhere. Please tick the correct answer: To achieve the above objective, from the list of installation components listed in Fig. 4., we will use the item: (+, B, Tr.P)*

a) serial switch - (circuit with two switches),
b) alternating switch - (circuit with two switches),
c) circuit with three switches (crossover switch).

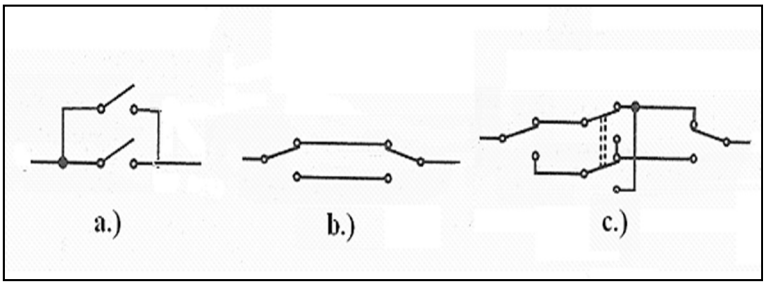

Figure 3. Created by M. Bernát

Re d) tasks for application of knowledge in problem situations mainly in practice - non-specific transfer

These are the tasks in which problems are formulated, the analysis being performed, the synthesis for the students of new phenomena, the formulas of the action, difficult tasks

are solved. The application also includes the use of the learned method of measurement in a specific situation.

T10 *When designing residential wiring, the beginner electrical engineer drew incorrect electrical wiring diagram (lighting), that was installed incorrectly and the lights don´t work. Can you correct the error in the wiring diagram in Figure 4? (use coloured pencil) (+, B, TrND)*

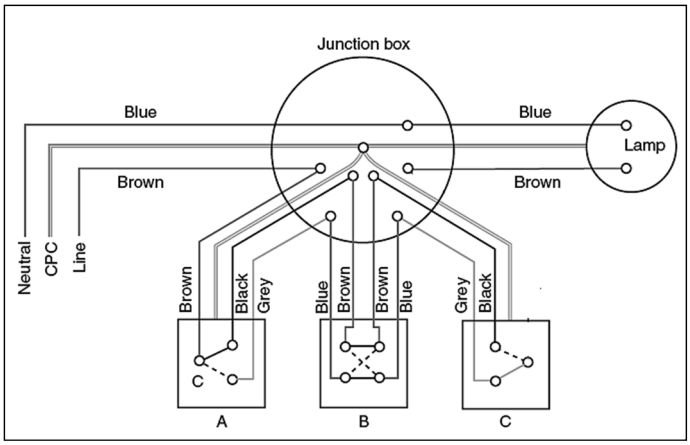

Figure 4. Created by M. Bernát

For completeness, let's mention the procedure for planning a didactic test based on the specific objectives list technique.

2.1.2 Specific objectives list technique (in DT planning)

With the specific objectives list technique, the planning of DT is based on specific objectives, i.e. definite and verifiable objectives. These objectives are described in the performance standard. This technique can be explained on a model for development of a didactic test in the selected problems Health and Safety Issues for teachers of naturalist subjects. As there is no performance standard available for this subject yet, developed by a central authority of state or "school administration", we had to develop it ourselves.

For the needs of further DT analysis, taking into account the level of learning (the taxonomy of the educational goals of by B. Niemerko), we can divide the DT tasks of didactic tests focusing on the selected problems health and safety issues for teachers of naturalist subjects into 4 subtests:

- subtest A - Remembering information (concepts, definitions, relationships) (R).
- subtest B - Understanding of information (relationships, laws, procedures) (U).
- subtest C - application of information I. - specific transfer (relationships, laws, procedures) (Tr.D).
- subtest D - application of information II. – non-specific transfer (TrND).

Table II. Specifications objectives list technique (in DT planning)

The university course of Electrical engineering for teachers education (thematic section Basics of Electrical Power Engineering). Study programme at the Faculty of Natural Sciences at the University of Prešov.

After (upon) studying the chapter, the student should know:

I. Thematic unit (Safety of work on electrical equipment)

Explain the difference between live and non-live parts of the electrical equipment and the difference between direct and indirect by touching **(+, B, U).;** Classify the size of the safe voltage in the environment **(+, B, R).;** Appoint the protective measures to protect against direct or indirect touch **(+, B, R).;** - Explain the differences between devices of safety class 0 to III **(+, B, U).;** Name the main factor that affects the physiological effects of electrical current on the human organism **(+, B, R).;** Propose a schematic algorithm for indirect heart and CPR massage **(+, B, TrD).;**

II. Thematic unit (Three-phase system)

Explain the principle of generating three-phase voltage by coils and magnet **(+, B, R).;** Draw the voltage curve in the three-phase system **(+, B, R).;** - Draw connecting the device to a power source according to star and triangle **(+, B, U).;** Know the effective phase and line voltage values in the low-voltage network in the Slovak Republic, **(+, B, R).;** To derive the relationship between phase and line voltages and also between phase and line currents **(+, B, U).;** Derive the relationship Write down formulas for the calculation of individual types of output in the three-phase system **(+, B, Tr.D).;**

III. Thematic unit (Generation, transmission and distribution of electric power)

Characterize the technological equipment in individual types of power plants **(+, B, U).;** Explain the principle of power transmission with emphasis on explanation of transformer function in electricity transmission **(+, B, U).;** List and recognize the schematic symbols of individual components of houses electrical wiring (identify mainly by name of the component) **(+, B, R).;** Recognize - the difference between the functional and the installation scheme of the residential electrical installation circuits of all basic wiring schematics of the electrical installation in the houses **(+, B, U).**; Identify, recognize and eliminate simple design errors in the installation schemstic of the electrical wiring in the houses (or individual errors in current installation) **(+, B, TrP).;** Design different simple application modifications of the basic circuits wiring diagrams in the houses **(+, B, TrND).;** Apply the knowledge in the design of a simple power distribution system in residential environment. **(+, B, TrND).;** - To draws and explain the basic technical principles of protection against dangerous touch voltage with specifics for electrical installation in the residential **(+, B, TrND).;** List the basic installation principles to be complied with in electrical installation **(+, B, TRPN).;** - Select a suitable electronic kit for installation works within the thematic unit **(-, B, U).;** - Practical application of a fast cursory check of the condition of components and circuits within the thematic unit **(-, B, TRND).;** Assemble (under teacher´s supervision) - using electronic kit - the basic circuits of the thematic unit **(-, B, Tr.D).;** Demonstrate - using the electronic kit - the functions of the circuits of the thematic unit Basics of Power Engineering **(-, B, TrD).;** Using the tester light bulbs (supervised by teachers) indicate the voltage of the electrical installation in the classroom **(-, B, TrD).**

When compiling this specification table (see Table I), it was decided that the didactic test would consist of 21 tasks, divided into individual thematic units of the curriculum so that it corresponds approximately to the percentage of lessons to be learned in each thematic unit. The table further specifies that 6 tasks in the didactic test should test the remembering of knowledge, 6 knowledge understanding tasks and 9 knowledge application tasks.

For each specific objective, it is necessary (as can be seen from the previous lines) to determine its importance, in particular whether it belongs to the basic curriculum, whether the curriculum contained in the specific subject can be tested with a didactic test and finally the required level of learning the subject matter within a specific objective. This is therefore the determination of the indicators for each specific objective: importance, testability, level of adoption.

Table III. Legend

	importance	testability	Level of adoption
List the methods of protection against indirect contavt	B	+	R
Demonstrate indirect heart message using plastic model	B	-	U

Legend: B - basic curriculum, + - tested objective (the knowledge contained within can be tested using the selected DTs), R - level of remembering, U - level of comprehension. Tr –transfer (application).

2.2 Designing the Didactic Test

Once the didactic test plan has been completed, it should be clear to the author of the test what, at what level and how many tasks should be used. When designing a didactic test, it is necessary to develop individual test tasks and to create the first proposal (prototype) of the didactic test. The test task is basically a question, problem or task included in the test. The pedagogical literature also uses the term test item, in practice also the terms question, problem are used.

2.2.1 Choosing the Form of the Test Tasks

Literary sources concerned with design of didactic tests list the following forms of tasks in didactic test[4]: Figure 5

[4] Turek, Ivan (2014): *Didaktika*, Bratislava, Wolters Kluwer 2017, ISBN: 978-80-8168-004-5 .

A. Open:
1. with broad answer
a. non-structured (A1a)
b. structured (A1b)
2. with brief answer
a. production (A2a)
b. fill-in (A2b)
B. CLOSED:
1. dichotomic (B1)
2. multiple choice (B2)
3. matching (B3)
4. sorting (B4)

Figure 5. Created by M.Bernát

Depending on how the student responds to the test task, we distinguish open and closed forms of tasks. The difference is that with open tasks, the student creates an answer, i.e. writes, draws, calculates. With closed answers, he/she can choose from offered answers only. The open tasks may have broad or brief answers.

(A) *Open Task)*

(A1) Open Tasks with Broad Answer

If a teacher uses an open, broad-based answer in the didactic test, the response to this task is to have provide a broad response (e.g. 1/2 pages ...), e.g.:

T11. *Describe types of protection against electric shock.*

Sometimes, with an open task with a broad answer, the teacher can define the structure of the required response (structured task), e.g.: List the methods of protection against direct contact List the methods of protection against indirect contact. Such open tasks with broad answer are easy to design but very difficult to score. It is virtually impossible to evaluate the responses to such tasks objectively, therefore they should only be used sparingly in the DTs. They are more suitable for the assessment of creativity.

(A2) Open Tasks with Brief Answer

It is more appropriate to include in the didactic test the open tasks with a brief answer, in which the student is required to write a short answer (sentence, word, few words, mark...). These tasks include the production and fill-in form of tasks. Example of a production test task.

T13. *What is the difference between one-pole and two-pole contact*

If they are in the form of an incomplete sentence, with answer to be filled-in, they are called fill-in tasks. For example:

T14. *Figure 6 shows a functional diagram drawing of an electrical wiring circuit of residential electrical installation. Please fill-in (using the provided space) the name of the electric circuit, with functional diagram shown in Figure 6. (+, B, U)*

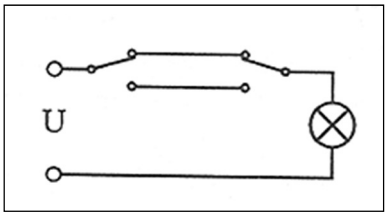

Figure 6. Created by M. Bernát

T15. *Using the provided space, provide the name of the city in Slovakia where the Slovak energy dispatch centre (SED) is located. It is locate in the city of ..... (+, B, R)*

T16. *Figure 7 shows the installation diagram of the electrical wiring circuit of residential electrical installation. Please use the provided space to fill in the name of this electric circuit.* ***(+, B, U).***

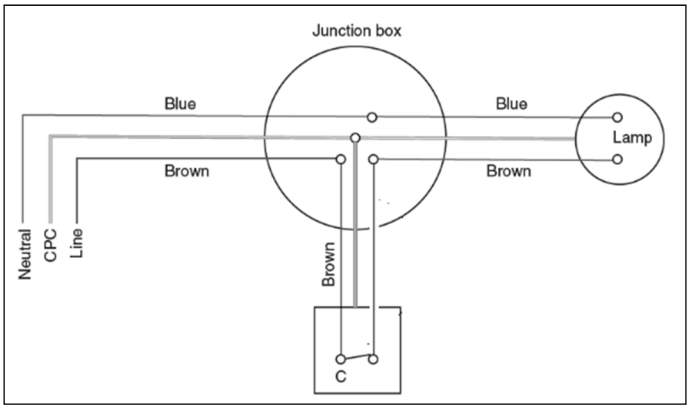

Figure 7. Created by M. Bernát

(B) Closed Tasks

(B1) Dichotomic (binary) Closed Tasks

Dichotomic tasks are represented by statements that can be answered in a binary way: yes-no, correct-incorrect. For example:

T17. *The extension cord must have two conductors.*

yes – no.

(B2) Multiple-choice Closed Tasks

Multiple-choice tasks are used most commonly. These multiple-choice tasks are used in several forms:

a) "single correct answer"
b) "single most accurate answer"
c) "single incorrect answer"

or other alternative modifications of these forms.
Find below several examples of the alternatives of the multiple choice tasks:

T18. *What colour is used to identify a protective conductor? Choose and tick the answer.*

a) light blue
b) green-yellow
c) yellow-black

I this type of tasks is used, the students should be cautioned that there may be several correct answers.

T19. *Choose the correct answer. (Attention: there may be several correct answers). The following equations apply to an ideal single-phase transformer:*

A. $U_2.I_1 = U_1.I_2$
B. $U_2/U_1 = I_1/I_2$
C. $U_2.I_2 = U_1.I_1$
D. $U_1/U_2 = I_1/I_2$

Note: (U_1, I_1 - voltage and current in primary coil, U_2 , I_2 - voltage and current in secondary coil)

Multiple-choice tasks with negation in the formulation of the task:

T20. *The following colour <u>may not</u> be used for STOP/OFF switch:*

a) red
b) green
c) black

For tasks of this type, the negative text in the task text should be highlighted e.g. by underlining, because it is easy for the responder to overlook it and answer incorrectly despite having the required knowledge.

(B3) Matching Closed Tasks

Matching tasks are based on two sets of terms and instructions. For each term in the first group (so-called label), the DT responder has to assign one of the terms of the second group (so-called add-ons) so that the assignment of the add-on to the label correctly reflects their relationship defined in the instruction.

For example:

T21. *Please mark (by circling) using the same colour in Figure 8 the pairs that match. The pairs consist of the name of the component of residential electrical installation and its schematic symbol used in the layout diagrams. For example the first pair is circled - grounding and its schematic symbol. (+, B, R)* [Name of the component of residential electrical installation; its schematic symbol]

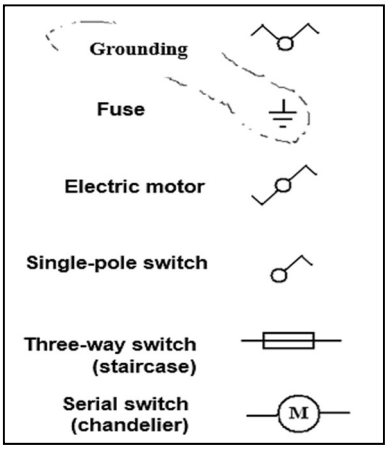

Figure 8. Created by M. Bernát

2.2.2 Appropriateness of Individual DT Task Forms for the Measurement of Individual Learning Levels [3]

Task form	Remembering	Comprehension	Application
Broad answer	-	-	+
Production	++	++	+
Fill-in	++	+	+
Binary	++	++	+
Multiple-choice	+	++	++
Matching	++	++	+
Sorting	+	++	-

The principle of the didactic test is based on the fact that the selected objectives from the tested curriculum are reformulated into the form of test tasks[5]. The performance standard includes the objectives to be met by all students. For example one of the objectives listed in the performance standard may have the following formulation: List (and identify) the schematic symbols of individual components of residential electrical wiring (identify mainly by name of the component). (+, B, R). The verb "list" is an instruction that tells us that this objective should be met by all students at the level of remembering the information. For this level of learning we can find suitable form of task in the table. Production, fill-in, binary or matching tasks are appropriate for the remembering level. If a matching (closed) form of the task is used, the test task may have the following format – (see T21, Figure 8).

2.2.3 Designing a Database of Test Tasks

As we have already mentioned, the principle of DT design is based on re-formulation of the specific objectives, defined in the form of test tasks. For each specific objective, with "+" symbol, i.e. one that can be tested, it is necessary to design at least one task (of course it is possible to design more in line with the required test parameters, e.g. the ratio of the tasks, testing individual learning levels or, in general, the importance of the specific objective).

For example:

Specific objective1: *Upon studying the chapter, the student should: Know the principle of nuclear power plant operation (+, B, U)*
Task testing the compliance with the objective1*: e.g.T23: Draw the principal diagram of a nuclear power plant, with annotation, and divide it into primary and secondary circuit. (+, B, U).*

[5] Bernát, M.(2015): *Visualization of some electro-physical process through computer for didactic purposes and its application in teaching electrotechnical subjects*. PhD. Thesis, PdF UKF Nitra 2015; Bernátová R.(2001): *Proposal for use of visualization of logical foundation of subject matter and its ways of application in connection with elevating effectiveness of a teaching process.,* Rokus 2001, Prešov, ISBN 80-89055-08-7; Bernátová, R., Bernát, M., Cimbala, R.(2009): *On Increasing Efficiency in Teaching Technical and Natural Sciences by Means of Java Applets II. (Experimental Research)*, Journal Of Technology And Information Education, vol. 1 issue 1, 2009; Harachová, D., Tóth, T. (2018): *Isertion ofteeth into engagementand their effect the deformation of the elastic wheel harmonic gear*, Ad Alta Journal Of Interdisciplinary Research, 2018, 265-267. Vol O8 No 01, ISSN: 2464-6733; Kreydenko, T., Chernyaev, M., Grigorieva, E., Korenevskaya, M. (2018): *Enhancing the energy efficiency of oil and gas companies as a factor their substanable development*, Ad Alta Journal Of Interdisciplinar Y Research, (2018), 08/01-IV, p. 176-183, ISSN: 2464-6733; Melezinek A.(1986) *Ingenieurpädagogik*: Praxis der Vermittlung technische Wissens techn. Wissens. Wien, New York, Springer, 1986; Pavlovkin, Ján a kol (2016): Elektrotechnika, Belianum, UMB BB 2016, ISBN 979 – 80- 557-0777-8; Satková, J. (2013): *Specifics of university experimental teaching of didactic disciplines in the fine art education,* Ad Alta Journal Of Interdisciplinary Research, 2013, Vol 03, No 02 , p.58-60, ISSN: 2464-6733; Trevor Linsley (2008) : Basic Electrical Installation Work, Fifth Edition 2008, ISBN 978-0-7506-8751-5; Turek, Ivan (2014): *Didaktika*, Bratislava, Wolters Kluwer 2017, ISBN: 978-80-8168-004-5.

Other examples:

Specific objective2: *Upon studying the chapter, the student should – name the basic principles (rules) to be complied with in electrical installations (+, B, R)*

Tasks, testing the compliance with the objective2*: e.g.T24: Please mark the correct answer. Which terminal is used to connect the phase conductor, when you are standing in front of a wall outlet, as per Fig. 9 (pin up) ? The phase conductor is connected to: (+, B, R)*

a.) left terminal b.) right terminal c.) pin

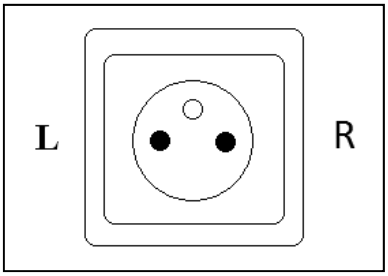

Figure 9. Created by M. Bernát

Specific objective3: *Upon studying the chapter, the student should: – Design various simple application modifications of the basic circuits of residential electrical installation. (+, B, TrND)*

Tasks, testing the compliance with the objective3: *e.g. T25: The designer developed a functional diagram for connection of a chandelier with two lamps. However, the client decided to use a chandelier with three lamps (lamp1, lamp2, lamp3) Propose a functional connection diagram enabling the control of three lamps in the chandelier, using three switches - (switch1, switch2, switch3). The original diagram is in Figure 10. (+, B, TrND).*

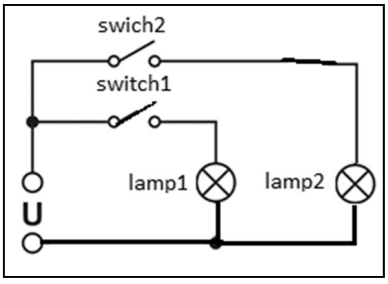

Figure 10. Created by M. Bernát

3. Summary and conclusion

The designer of a didactic test is seldom successful in proposing perfect test tasks at first attempt. It is appropriate to have the test tasks evaluated by an expert, e.g. colleague teaching the same subject.

The draft (prototype) didactic test is then assembled using the proposed test tasks with positive assessment by experts. The test development should include the determination of the time available to complete the test. When determining the duration of the DT, it is necessary to consider especially the number and difficulty of the test tasks to be included in the DT, as well as the number of tasks. In general, about 1 to 1.5 minutes are required to complete each objective task, unless calculation is involved. The time limit should be determined loosely and mostly the student should be left to work practically without time limit. A more accurate estimate of the time required to complete the task can be determined upon first use of the didactic test on a sample of students.

A database of didactic tests oriented on selected problems Health and Safety Issues for Teachers of Naturalist Subjects[6]. The authors will be glad to make them available to anyone interested.

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Contribution to pedagogical diagnostics in teaching focused on health and safety at work for teachers of naturalist and technical subjects

The paper describes a research topic dealing with the methodology of planning, design and application of a didactic test oriented on selected problems Health and Safety Issues for Teachers of Naturalist Subjects. Specific problems of the topic are the creation and use of the tests as a form of investigation of the knowledge and skills of the students as well as the objectivity and reliability of the tests.

Keywords: Teaching science and technology subjects. Fundamentals of Health and Safety at Work and Safety of Technical Equipment.

Wkład w diagnostykę pedagogiczną w nauczaniu dotyczącym bezpieczeństwa i higieny pracy dla nauczycieli przedmiotów przyrodniczych i technicznych

W artykule opisano temat badawczy dotyczący metodologii planowania, projektowania i stosowania testu dydaktycznego zorientowanego na wybrane problemy bezpieczeństwa i higieny pracy dla nauczycieli przedmiotów przyrodniczych i technicznych. Specyficznym problemem w tym zakresie jest tworzenie i stosowanie testów jako formy badania wiedzy i umiejętności uczniów, a także obiektywność i wiarygodność testów.

Słowa kluczowe: Nauczanie przedmiotów ścisłych i technicznych. Podstawy bezpieczeństwa i higieny pracy oraz bezpieczeństwa urządzeń technicznych.

Translated by Anna Oleszak