R&E-SOURCE https://journal.ph-noe.ac.at
Online Journal for Research and Education
Special Issue 17, Dec. 2019, ISSN 2313-1640

Learning tasks supporting formative assessment of students within the subjekt focused on Electrotechnics

Milan Ďuriš

Abstract

In the article we pay attention to formative assessment of students within the subject Technique in elementary school, where the focus is put on the feedback and self assessment of students. As a demonstration we submit proposed and experimentally proven electronic tasks focused on content of topics in the Electrotechnics. Electronic tasks also include self monitoring protocol of student, in which the student marks by the answer, how well he/she understood the given topic. The problem of formative assessment of students is dealt with as a part of project KEGA nr. 017UMB-4/2017 under the title Formative assessment of students within the subject Technique in lower secondary education with focus on cognitive field.

Keywords:	*Schlüsselwörter:*
Elementary school	...
Subject Technique	...
Formative assessment	...
Electronic learning tasks	

1 Introduction

The subject Technique has specific position in the system of learning subjects of lower secondary education in the Slovak Republic and may not be replaced by any other subject. So as with other subjects in lower secondary education, within the subject Technique the transmissive way of teaching and assessment of students´ performance by means of the grade is still prevailing. With regards to practical and applicative character of the subject and in accordance to current educational trends in the field of assessment, the attention is transferred from quantitative assessment of student by teacher to more qualitative assessment and development of self-assessment of students themselves. This requires, also for the reason of recent changes in curriculum of the subject, implementation of new innovative assessment methods and means in the educational process.

In case of application of summative assessment of students´ performance (classification) in the elementary school (ES) the students are often put under stress and they learn just to get good grades. Students are often just passive objects in process of examination of their knowledge and assessment. The goal of assessment of student should not be just to assess his/her current performance; instead, it should lead to formative assessment and self-assessment of student. The basis of self-assessment is that students themselves are responsible for their learning and they become active part of the learning process. From the didactic point of view it is possible to understand the self-assessment as a competence supporting freedom and independence of student from the teacher. Therefore, the self-assessment and self-control constitute the most important motivation means for student. Formative assessment of students within the teaching process is focused to getting feedback on the progress of student´s learning, as well as the feedback on deficiencies and mistakes with the goal for their remedy. Such types of students´ assessment doesn´t include classification.

As mentioned by several authors (Turek, 2014, Kalaš, 2013 and others), the formative assessment of students should be used in a bigger scale because it improves the quality of knowledge and skills of students. Numerous foreign researches prove that from methodical point of view the correct use of activating assessment strategies and methods supporting formative assessment is often connected to improvement of learning results of students (Shute and Kimy, 2014, Koedinger, McLaughlin and Hefferman, 2010).

2 Learning tasks supportive formative assessment of students

Solving of learning tasks forms a part of meaningful activities of students during the lesson. By means of such teaching method the teacher fulfils determined specific goals of the lesson. Technical, application and creative tasks in particular have high potential to connect theory with practice, and practical usage of the

knowledge. This function of learning tasks within the subject Technique is important for improvement of learning results of students and their inner motivation towards learning. The learning task should stimulate and shape their activities, in order to repeat, acquire and consolidate their knowledge, skills and behaviour, as well as develop their abilities and create own approaches. Learning tasks should further develop students´ ability of team work, skills to use the literature and electronic information sources, ability to choose suitable working methods, acquire mental operations necessary for problem solving, etc. Within the teaching process we do not deal with sole or randomly collected learning tasks; instead we deal with creation of programmed collections of tasks, arranged from the simple to difficult, from algorithmic to creative. Learning tasks are included in the whole teaching process by the teacher in a way strengthening their formative function. Learning tasks have significant influence on quality of students´ knowledge, its long-term duration and practical usefulness.

The particular knowledge, skills, behaviour, approaches and competences which are to be acquired by students within the subject Technique are determined in specific goals by the teacher. When defining specific goals the teacher emanates from the performance standard, and specific goals become a part of methodical preparation for specific teaching lesson of the subject Technique. Within the subject Technique we apply Niemierko´s taxonomy of educational goals in cognitive field. According to that learning tasks may be divided to tasks for memorizing and understanding the knowledge, tasks focused on use of knowledge in typical and problematic, non-typical situations. In order to cope with learning tasks on the highest level it is necessary to be able to solve learning tasks on lower levels. It is necessary to arrange learning tasks into a complex compilation, containing learning task of various difficultness and variety, so that it develops broadly key and specific competences of students.

Practicing and consolidating of students´ knowledge and skills belong among the most important, although often underrated parts of the teaching process. In order to achieve useful practice it is necessary to provide students not only with opportunities to use their knowledge and skills, but also to provide them with timely feedback. It doesn´t have to be summative and evaluative, instead it should fulfil formative function and provide students with information that may help them in self-assessment of their progress from the point of view of educational goals, in understanding and correcting mistakes and misconceptions. The goal is to achieve that students better understand the value of acquired knowledge and its meaning in practical life.

2.1 Electronic learning tasks for selected topics in the subject Technique

Since the electronic learning tasks supporting formative assessment of students that we have proposed are focused on the field of Electrotechnics, it is necessary to briefly define the thematic circle, which focuses to given field within the subject Technique.

The thematic circle *Electric power, electric circuits* constitutes one of five main topics of the subject Technique for the students of the 6th grade of elementary schools. Educative standard of the Technique (ŠPÚ, 2015) defines the content of the topic in the content and performance standards.

The content of thematic circle *Electric power, electric circuits* includes the production, distribution, use and saving of electric energy in industry and households. The focus is put on essential sources of electric power (renewable, non-renewable and alternative), and also to battery sources and accumulators. Attention is paid to various types of power stations (thermal, hydroelectric, solar, atomic – nuclear, geothermal, wind), in which the certain form of energy is transformed to electric power.

In the thematic circle the attention is paid to basic elements of simple electric circuit (battery, cell wire, bulb, switch), and their schematic marks, which constitutes the basis for connection of simple electric circuit. Students gain practical skills and habits in mechanical compiling and connecting of electric device (for ex. a bulb) in series (successive), or in parallel (side by side) in the simple electric circuit. According to school possibilities students also use electronic kits for connecting of electric circuits. Within this thematic circle the teacher pays attention also to possibilities of collecting and separating the hazardous waste (bulbs with burned thread, discharged batteries, accumulators, etc.).

The aim of electronic learning tasks is to find out, whether at the end of 6th grade of elementary school the student is capable to execute the expected performance as specified in performance standard of the given thematic topic, based on the knowledge, its understanding and acquiring. When creating electronic learning tasks we were taking into account real conditions occurring in current elementary schools. Since our aim is to solve the given tasks during one lesson, we are proposing four tasks that students should be able to solve and assess.

Since the proposed electronic learning tasks are supposed to support the formative assessment of student, with each electronic task we are also presenting a *Self-monitoring protocol of student*, in which the student can mark how many attempts he/she needed in order to achieve a correct solution of the task. The protocol shall

also include a comment of the student regarding solving of the learning task (for ex. brief reasoning of the correct answer, she understood the given learning content, which is a part of the learning task. By this the student obtains immediate feedback on how he/she acquired the learning content, how he/she understood it, how he/she was able to cope with the task, which forms an essential part of the formative assessment of student. Moreover, the student is able based on his/her critical thinking and based on his/her own assessment mark the level of understanding of the learning content and select one of the three offered answer possibilities (*very well, well, need to improve*).

Learning tasks proposed by us are in line with Niemierko`s taxonomy of educational goals focused on understanding the knowledge and its applying in typical problem solving situations. Electronic learning tasks consist of following tasks:

Task nr.1: (focused on a specific transfer) – animation shall depict a simple electric circuit, formed by several elements. The student´s task will be to choose the answer, which contains basic elements of electric circuits presented via animation.

Task nr.2: (focused on understanding) – video shall demonstrate the basic principle of operation of power station using the renewable source of energy. The student´s task will be to choose the answer, which contains the correct name of power station presented in the video.

Task nr.3: (focused on specific transfer) – the student´s task will be to form the simple electric circuit in the way, that the bulb will be on, with the help of simulation. For the purpose of simulation the student will have at his/her disposal a battery, a switch, a bulb and cell wires. After connecting the circuit the student will have to answer the question of element, without which the bulb would not turn on in the electric circuit. The student should verify his/her answer by the simulation of electric circuit, that he/she formed.

Task nr.4: (focused on specific transfer) – the student´s task will be to form the simple electric circuit so that two bulbs in the circuit will be lightened, at first one after the other (in series) and then side by side (in parallel). After connecting the circuit student should compare the brightness of both bulbs. The student should also answer the question, in which type of connection the brightness of bulbs was higher.

The compilation of electronic tasks should serve as the means of formative assessment of students within the learning process. Used software application has built in feedback, i.e. the student is provided with the information on correctness, or failure of the solution immediately after his/her performance. If student fails in solving the task, he/she may be offered a certain form of help from the application itself, or a teacher, until achieving the correct solution.

Acquiring of knowledge, its repetition and practical use are mutually dependent parts of learning process. Only those knowledge and skills have real meaning for the student, which he/she is able to practically use. As for repetition, it is necessary to reduce often very unproductive verbal reproduction of the learning content. This phase of the learning process must be organized by the teacher in a way, which enables students to develop their theoretical knowledge in new connections and relations, and in practical activities. By this students are able to repair their incorrect ideas that may have appeared within the exposition phase of the learning process". (Skalková, 2007, pg.154)

The use of compilation of electronic learning tasks in the fixation phase shall constitute a new element, new situation for the student within the learning process, which is in line with opinion of Petlák (2004), who adds to this issue that „*in the fixation phase of the learning process it is necessary to repeat and anchor the learning content mainly in new, unknown situations and conditions". (*Petlák, 2004, pg.88)

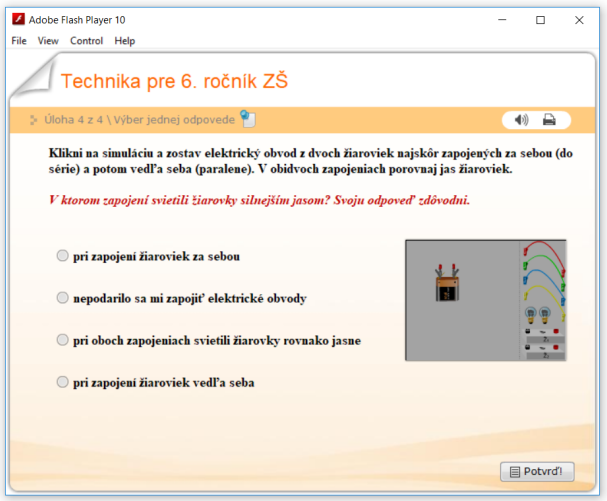
Fixation phase in the learning process serves for anchoring and repetition of learned content. However, it also fulfils other important functions. We would like to mention those that are essential for applying of the learning tasks proposed by us:

a) it enables a fast feedback within the process of learning of student,
b) it enables immediate correction of mistake,
c) the student is testing his/her level of abilities as well as result of his/her work,
d) in case of success the student is happy of his/her personal growth,
e) *this phase enables student to apply the acquired knowledge and skills in practice when solving new tasks and problems.* (Hrmo, Krpálková-Krelová, 2010, pg.150)

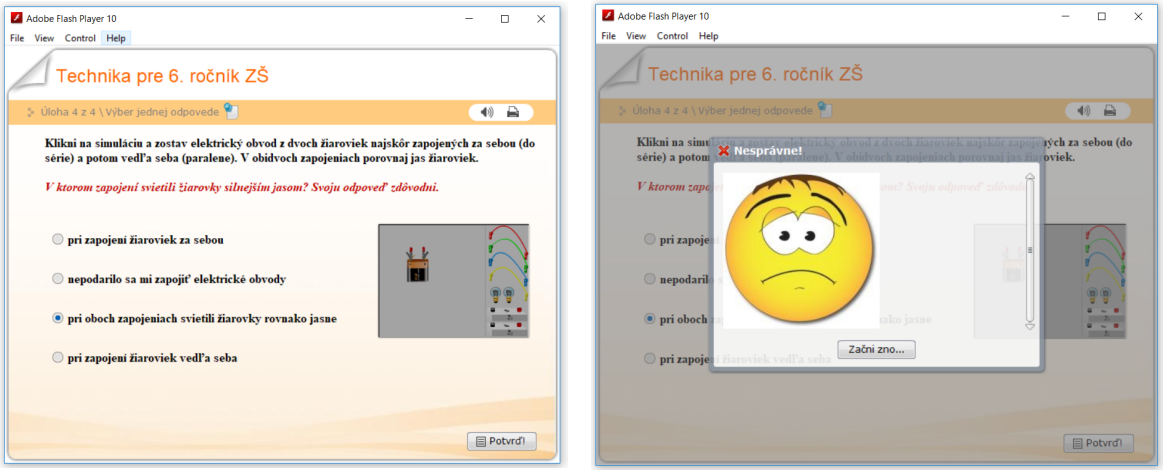
3 Demonstration of electronic learning task solving

For the reason of limited extent of this article we are presenting the demonstration of only one learning task.

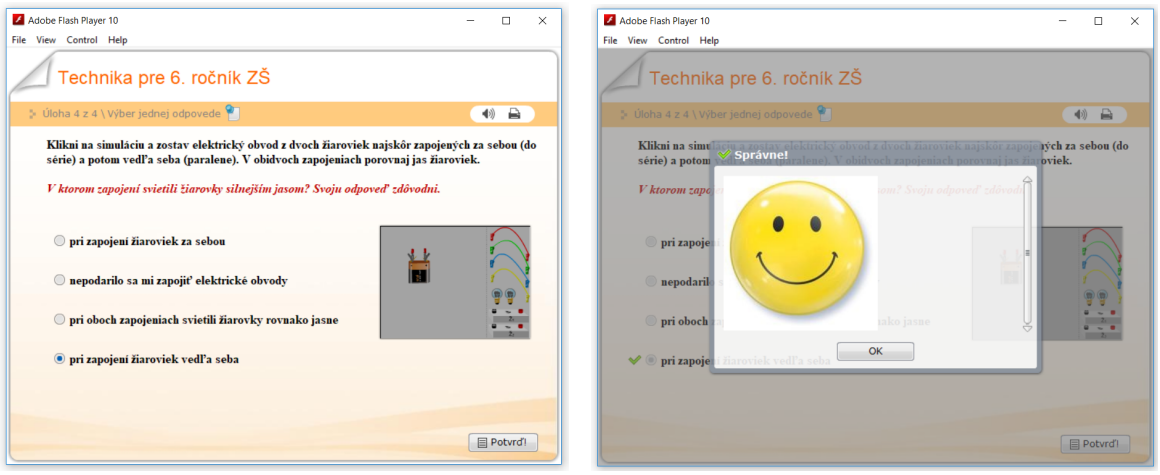
Assignement and solution of the task nr.4



Pic.1: Assignement of electronic task nr.4 (source: own suggestion)

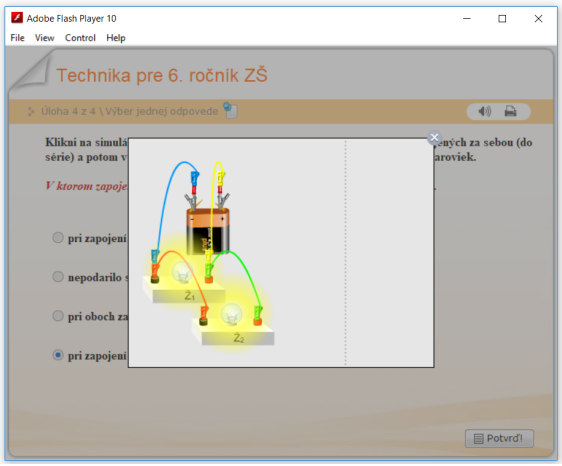


Pic.2: Incorrect solution of electronic task nr.4 (source: own suggestion)



Pic.3: Correct solution of electronic task nr.4 (source: own suggestion)

Pic.4: Correct connection of bulbs in series, solution of electronic task nr.4 (source: own suggestion)



Pic.5: Correct connection of bulbs in parallel, solution of electronic task nr.4 (source: own suggestion)

In *Self-monitoring protocol* the student marks by „X“) how many tries he/she needed until achieving correct answer to electronic task nr.4. At the same time he/she writes the brief reasoning of the correct answer, sums up the level of difficulty and clearness of the given task. In the table below within the protocol the student marks (by „X“), how he/she understood the learning content (self-assessment of student). Self-assessment is focused on practical skills in connecting of two bulbs in series (one after another) and in parallel (side by side) by means of simulation in electronic kit and according to task assignment. Based on acquired knowledge the student explains why there is a difference in the brightness of bulbs´ light when connected in series and in parallel.

Task number	Correct answer at first try	Correct answer at second try	Correct answer at third try	Correct answer at fourth try
4.				

The comment regarding solving of the task (brief summary of correct answer, level of difficulty, clearness of assignment):

.....

.....

Mark in each line (by mark „X“) of the table, how well you understood the given learning content and how was it to work on this task.

How did I understand this learning content? How difficult it was to work on the task?	Very well	Well	I need to improve
1. I am able to create connection of two bulbs in series in the electric circuit.			
2. I am able to create connection of two bulbs in parallel in electric circuit.			
3. I am able to compare the brightness of two bulbs connected in series and in parallel.			
4. I am able to create electric circuit according to assignment by means of electric kit simulation.			

Pic.6: Self-monitoring protocol of student for the electronic task nr.4

Conclusion

An issue of formative assessment of students may be integrated within the field of Pedagogical science and the discipline 1.1.10 Subject didactics – didactic of specialized technical subjects. Since the beginning of school reform in 2008 in Slovakia no attention was paid to this issue in technical subjects, neither in theoretical level, nor in application form. At present we pay attention to this issue in theoretical level and application form not only within the part of KEGA project, but also in various publication works, for ex. Ďuriš, Stadtrucker (2016), Ďuriš, Pandurović, Stadtrucker(2017, 2018). Authors (Ďuriš, Stadtrucker, Pandurović) in their university textbook (2019) present strategies and methods of teaching that support formative assessment of students in the subject Technique. In the scientific monograph published in 2019 authors (Ďuriš, Stadtrucker, Pandurović) present results of research focused on application of proposed electronic learning tasks in fully organized elementary schools in Slovakia. Achieved results confirmed an eligibility of application of students´ formative assessment by means of appropriate learning tasks. Works of these authors may be considered a significant contribution in pedagogical theory and practice, since they constitute appropriate help and guide not only in didactic application of students´ formative assessment in selected topic, but also in other scientific activities, which are inevitable to be performed in the future, as a part of broader content of the subject Technique and based on a greater scientific sample.

References

Ďuriš, M., Stadtrucker, R. & Pandurovič. I. (2019). *Stratégie a postupy vyučovania podporujúce formatívne hodnotenie žiakov v predmete technika*. Banská Bystrica: Belianum.
Ďuriš, M., Stadtrucker, R. & Pandurovič. I. (2019). *Formatívne hodnotenie žiakov v kognitívnej oblasti v predmete technika.* Banská Bystrica: Belianum.
Ďuriš, M., Pandurovič, I. & Stadtrucker, R. (2018). *Application of digital competence of the teacher in innovative approach of students' assessment by means of interactive electronic exercises*. Zielona Góra: Uniwersytet Zielonogórski, pp.51–68.
Ďuriš, M., Pandurovič, I. & Stadtrucker, R. (2017). Teachers digital competence in innovative approach to assessment of students by means of interactive electronic exercises. In 42nd ATEE Conference 2017.*Changing perspectives and approaches in contemporary teaching*. Osijek: Fakulty of Education, pp.104-105.
Ďuriš, M., & Stadtrucker, R.(2016). Inovatívny prístup hodnotenia žiakov v predmete technika s využitím elektronických interaktívnych úloh. *Journal of Technology and Information Education*. Roč. 8. Číslo 2. pp. 105–116. DOI 10.5507/jtie.2016.022.
Hrmo, R. & Krpálková-Krelová, K. (2010). *Zvyšovanie kvality vyučovacieho procesu.* Bratislava: STU, 2010.
Kalaš, I. et. al. (2013). *Premeny školy v digitálnom veku*. Bratislava: SPN.

Koedinger, K. R., McLaughlin, E.A. & Hefferman. N.T. (2010). A quasi-experimental evaluation of an on-line formative assessment and tutoring system. *Journal of Educational Computing Research*, vol. 43/4/2010, 120-145.
Petlák, E. (2004). . *Všeobecná didaktika.* 2. vyd. Bratislava: IRIS.
Shute, V. J. & Kimy, J. (2014).Formative and stealth assessment. *Handbook of research on Educational communications and Technolgy*, vol. 5/2014, 311-321.
Turek, I. (2014). *Didaktika*. Tretie, prepracované a doplnené vydanie. Bratislava: Wolters Kluwer.
Skalková, J. (2007). *Obecná didaktika*. Druhé rozšírené a aktualizované vydanie. Praha: Grada,
ŠPÚ. (2015). *Inovovaný ŠVP pre základné školy. Štátny vzdelávací program, nižšie stredné vzdelávanie – 2. stupeň základnej školy*. Bratislava: ŠPÚ.

Affiliation of author: Faculty of Natural Sciences, Matej Bel University Banská Bystrica, Tajovského 40, 974 00 Banská Bystrica.
Corresponding author. E-mail: Milan.Duris@umb.sk