

FORMATIVE ASSESSMENT METHODS IN BIOLOGY EDUCATION: PEDAGOGICAL STUDY AT PRIMARY SCHOOL IN THE CZECH REPUBLIC

L. Rokos, Lrokos@pf.jcu.cz,
R. Zavodska, radkaz@pf.jcu.cz,
J. Petr, janpetr@pf.jcu.cz,
M. Papacek, papacek@pf.jcu.cz

University of South Bohemia, Ceske Budejovice, Czech Republic

Empirical investigation represents crucial competence which pupils can gain during inquiry-based biology education. There is a significant methodological problem with the assessment of pupil's performance during the inquiry-based biology education because the classical summative assessment is not able to capture pupil's progress and take all pupil's activities into consideration. The formative assessment can help teachers and pupils to feel more confident in the partial steps of inquiry-based biology education and improve their achievements. For this reason, the formative assessment methods are determined as an ideal assessing approach.

Keywords: education, assessment, formative assessment, inquiry-based education, biology, elementary school, Czech Republic.

Introduction and research question

The increasing implementation of inquiry based tasks into science subjects reveals the problem with assessing the pupils' performance during these activities. Short and final summative assessment of the pupil's performance is not appropriate method due to the lack of possibility to observe pupil's progress during the whole inquiry task and in all its steps.

Inquiry based tasks contain specific steps, from identifying the research question, formulating the hypothesis, planning and performing own experiments, analyzing and interpreting gained data to summary of results and using the models (Anderson, 2002). Thus, it is convenient to have assessing method which is able to provide the information about pupil's achievement in real time, which goals s/he has already achieved and mainly which part of his/her work needs some improvement for the achievement of the selected goal.

Popham [2006; 2008] characterizes formative assessment as a process in which the information gained from the assessment is used for the improvement of next steps in the teaching-learning process and to help pupils to reach the selected goals. The proper timing and implementation of formative assessment can lead to the improvement of progress in teaching-learning

process and also to better understanding of particular steps during the inquiry process and their acquirement after that [Melmer a kol., 2008; Black a Wiliam, 1998].

The formative assessment can include various methods, from self-assessment, peer-assessment to teacher's assessment and it can also monitor various aspects of teaching-learning process. These methods have certain common features and their purpose is to help pupils in the learning process. Peer-assessment is one of the formative assessment methods. Pupils evaluate the quality of peer's work or level of his/her performance. Afterwards they decide to what extent the peer has met set goals or criteria and guide him to improve his work and get closer to the criteria. Decisions how to reach next learning steps are made on the base of pupil peer assessment or self-assessment and feedback is given to the pupils directly from their peers. Topping [2009, 2013] found out a positive correlation between pupils' achievement and peer-assessment as the formative assessment methods. Pupils who were involved in the peer-assessment process (e.g. point to strengths and weaknesses of peer's project, suggest the changes etc.) submitted better own works afterwards compared with pupils who received feedback from teacher and were not involved in the peer-assessment.

The peer evaluation is not a deep-rooted assessing method in Czech education. This evaluation is limited by grading of peers and it usually does not enable progress of the formative component in assessment. Thus, the results from the international project ASSIST-ME are really important and interesting for the Czech educational system.

Principles of the study
and project ASSIST-ME

The international project of the 7th Framework program called ASSIST-ME (*Assess Inquiry in Science, Technology and Mathematics Education*) is a high level research project that will investigate formative and summative assessment methods to support and to improve inquiry-based approaches in European science, technology and mathematics education. This project is implemented into education systems in 8 European countries (specifically Denmark, Germany, Cyprus, Switzerland, France, Great Britain, Finland and Czech Republic) and 10 educational institutions cooperate in it. The Czech Republic is represented by the Faculty of Education, University of South Bohemia in Ceske Budejovice (namely by department of Biology and department of Psychology and Pedagogy). The overall

aim of this project is to verify the efficacy of the formative assessment as well as to map the situation of this assessment approach in selected European countries and to design a range of appropriate assessment methods which would supplement current assessment tools.

The project is divided into the three phases and work packages (WP). Each package is focused on partial activity in proceeding work in the project. The work package had a coordinator who was supervising the work in it and also was responsible for fulfilment of goals and for the publication of results. The whole scheme of the project is described in Fig. 1. The work package number one is missing in the scheme because it is closely connected to administrative works and steering the whole project. The main coordinator of this project is the University of Copenhagen, Department of Science Education.

Implementation of the study
in the Czech Republic

There were established two local groups observed the development of empirical investigation competence (LWG1 and LWG2) in biology lessons at primary and lower secondary level. Each LWG contained 6 teacher and 2 researchers. Both LWGs were focused on formative

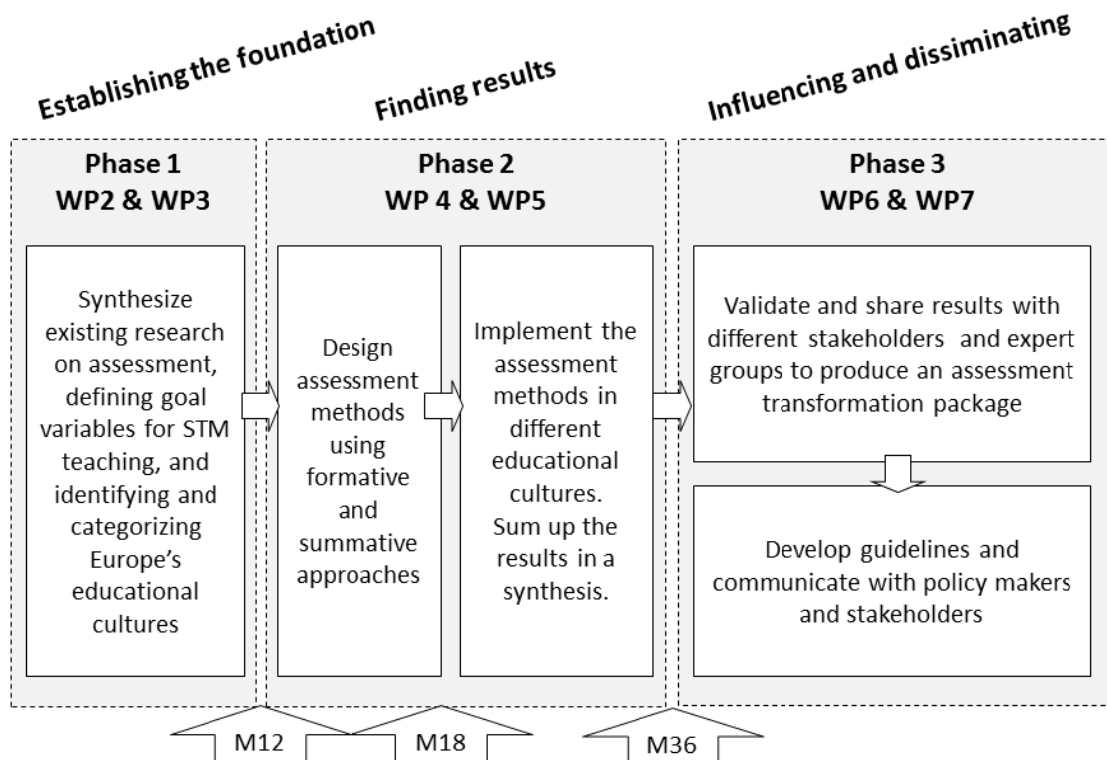


Fig. 1. Scheme of ASSIST-ME project.
Legend: M – month of solving the project; WP – work package

LWG	Level	Competence	Subject	Topic	Number of pupils*
LWG1	Primary	Empirical investigation	Biology	Plant physiology	22, 24, 28
LWG2	Lower-secondary	Empirical investigation	Biology	Plant physiology, Human physiology	25, 22, 23

Fig. 2. Czech local working groups and their foci:

* number of pupils involved in the peer-assessment (i.e. without control group)

assessment, specifically peer-assessment. The details related to each group are summed up in the Fig. 2.

The research team had many research questions to deal with. Some of them were common questions for all project partners, the others were related specifically to Czech educational environment. The main research question was the comparison of formative and summative assessment and the study of their potential in inquiry-based tasks. In this paper we present the results of partial study in which we were interested in pupils' attitudes to formative assessment and their reaction during assessing their peers. The main research questions were the following ones: 1) Do pupils accept peer assessment and use it for improvement of their products?; 2) Do they take peer assessment seriously, ignore it, or direct boycott it?; 3) How do pupils react to the assessment from classmates?; and 4) Do they prefer assessment from their peers to evaluating from teachers?

Method of the empirical investigation

The peer-assessment as the formative assessment method was implemented into the inquiry biology lessons at primary and lower secondary level at selected schools in the Czech Republic. As it was stated above there were 2 local research groups focused on biology lessons, first one at primary level and the second one at lower secondary level. The research had 3 rounds and there were performed interviews with the teachers as well as with all pupils before the start of the research and immediately after finishing it.

In the experimental session, pupils designed their own experiment and their designs were assessed by their peers. In total 291 pupils and 12 teachers at 8 schools in South Bohemia were involved in this research. Pupils were divided randomly into experimental group (received feedback from their peers) and control group (received feedback from the teacher) with the program GraphPad QuickCalcs. The experimental

and control groups were established in the same class to ensure the same conditions.

The peer assessment and inquiry lesson were implemented in the teaching block of 8 classes. The research design contained two rounds of peer feedback. The steps are described in the following points:

- Inquiry activity: Pupils design their experiment (containing hypothesis, tools, procedure and discussion of factors which have influence on the results) related to selected topic and practicable in school conditions.

- Teacher's assessment: The teacher assesses all pupils' protocols, assessment is written directly into the computer; researcher controls the protocols and makes copies.

- Peer assessment: Each pupil of the experimental group receives protocol from his/her peer and writes assessment on his/her experiment design to the same kind of form as teacher wrote. Control group has different work not-related with the research.

- Correction and evaluation: Pupils get back their protocols and assessment forms and based on it they correct their design of experiment. The teacher evaluates quality of peer feedback and the level of acceptance of suggested changes.

- After correction the pupils perform their own experiment, gain data, discuss them and write conclusions. The whole procedure with assessment repeats again.

Pupils at primary level used simplified model of protocols. They didn't write the procedure of own experiment but drew the scheme of it. They also worked with simplified version of feedback protocol but they were still asked to provide it in written or drawn form.

Results

The peer assessment was found as appropriate method for assessing pupils' performance in inquiry biology lessons. Pupils accepted feedback from their peers but on the other hand they had

problems with providing it. They need the guidance how to assess or how to express their ideas.

Moreover we were interested in the acceptance of peer-assessment among the pupils. Pupils were asked whether they preferred commentaries in the written feedback or the final grade. Three quarters of pupils chose the commentaries (Fig. 3) as the most useful part of the feedback. After that they added these commentaries are better understandable for them and they know what to improve in their next work.

They also stated that the feedback helps

them to improve their product (independently on the provider of feedback; Fig. 4). Both groups, experimental and control, found the written commentaries more helpful than classical grades.

Beside this fact we asked the pupils whether they prefer assessment from teacher or from their peers. During the experiment there were no boycotting of the peer feedback but most of pupils would prefer the teacher's assessment (Fig. 5). In the additional question they quoted that their teachers are better education, more responsible, trustworthy so they trust them more than their peers.

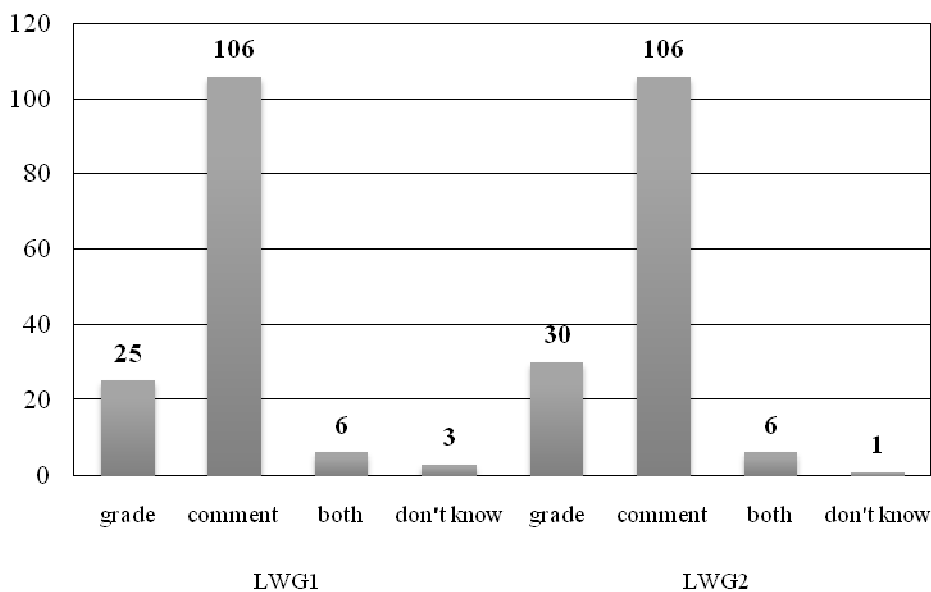


Fig. 3. Pupils' preference in the provided feedback.
Legend: LWG1 – local working group at primary level,
LWG2 – local working group at lower secondary level

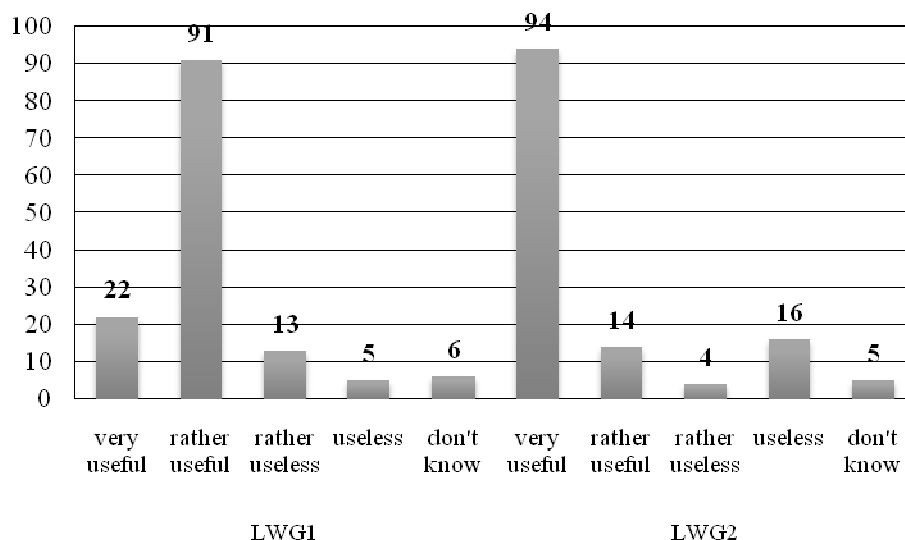


Fig. 4. Pupils' opinion on usefulness of provided commentaries.
Legend: LWG1 – local working group at primary level,
LWG2 – local working group at lower secondary level

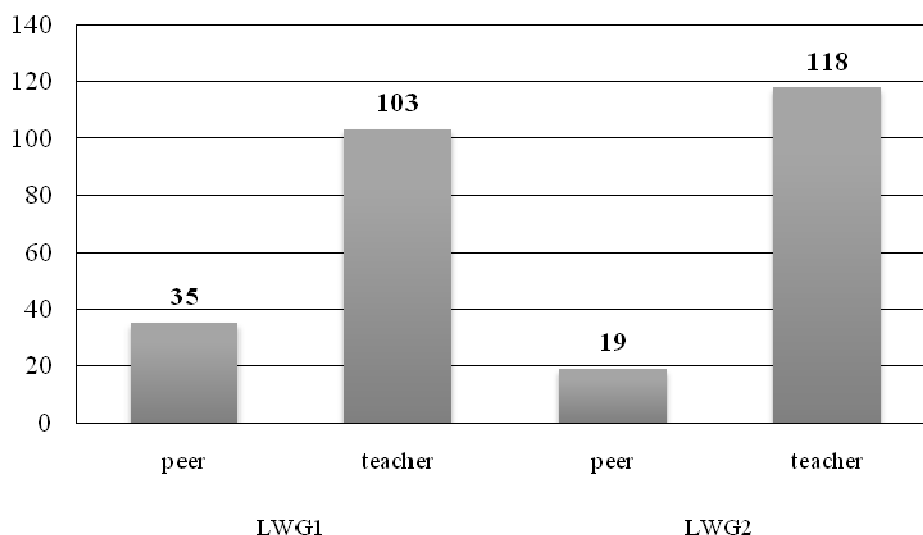


Fig. 5. Pupils' preference of assessing person
 Legend: LWG1 – local working group at primary level,
 LWG2 – local working group at lower secondary level

Conclusion

The peer-assessment seems to be a perspective method for assessing pupils in the inquiry lessons in biology at primary and lower secondary level. This assessment method enables to evaluate pupils' performance in all steps of inquiry tasks. Although the peer-assessment is a combination of formative and summative assessment, the formative non-evaluative peer-feedback is the most important component of this assessment [also see Topping, 2013].

If we draw a comparison of experimental group (received feedback from peers) and control group (received feedback from teacher) both groups accepted the feedback in the same way. The pupils prefer written commentaries rather than classical grades and they found them helpful for improvement of their product as well as for their future work. Interesting finding is the fact that pupils still prefer assessment from teacher because of its quality and credibility.

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МЕТОДЫ ОЦЕНИВАНИЯ РЕЗУЛЬТАТОВ ОБУЧЕНИЯ БИОЛОГИИ У УЧЕНИКОВ НАЧАЛЬНОЙ ШКОЛЫ ЧЕХИИ

Л. Рокос, Р. Заводска, Я. Петр, М. Папасек

Южночешский университет, г. Ческе-Будеёвице, Чешская Республика

В исследовании представлен практический опыт изучения ключевой компетенции, которую получают ученики при изучении биологии с помощью метода открытий. При этом существует важная проблема оценки результатов работы учеников, так как классический метод оценивания – рубежный контроль, не позволяет оценить прогресс ученика в изучении дисциплины и не охватывает всех аспектов его деятельности. Промежуточный контроль помогает студентам и учителям чувствовать себя более уверенно при использовании метода открытий и повысить результаты обучения. Поэтому методы промежуточного контроля определяются как идеальный инструмент оценки обучения.

Ключевые слова: обучение, оценивание результатов, промежуточный контроль, метод открытий, биология, начальная школа, Чешская Республика.

Лукас Рокос, магистр, аспирант кафедры биологии, Педагогический факультет, Южночешский университет, г. Ческе-Будеёвице, Чешская Республика, Lrokos@pf.jcu.cz.

Радка Заводска, доктор педагогических наук, доктор философии, доцент кафедры биологии, Педагогический факультет, Южночешский университет, г. Ческе-Будеёвице, Чешская Республика, radkaz@pf.jcu.cz.

Ян Петр, магистр, доктор философии, ассистент кафедры биологии, Педагогический факультет, Южночешский университет, г. Ческе-Будеёвице, Чешская Республика, janpetr@pf.jcu.cz.

Мирослав Папасек, доктор наук по естественнонаучным дисциплинам, профессор, профессор кафедры биологии, Педагогический факультет, Южночешский университет, г. Ческе-Будеёвице, Чешская Республика, rapasek@pf.jcu.cz.

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