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Original Contribution

USING INFORMATION TECHNOLOGIES TO CARRY OUT FORMATIVE ASSESSMENT

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ABSTRACT
The current study discusses the nature and the main features of formative assessment. It summarizes the different strategies that teachers use to carry out formative assessment in the educational process. The study discusses the opportunities of LMS Moodle for implementation of activities that support formative assessment.

Key words: education, formative assessment, feedback, learning management systems

INTRODUCTION

Learners' assessment is an integral part of the educational process. Through the process of assessment information about the learners' knowledge and skills is gathered and interpreted in order to determine the level of correlation between achieved results and established standards (1). Objects of assessment are both the learners' knowledge and their skills and competences. Usually the focus of assessment is summative assessment. It takes place in specific periods of time (at the end of the semester, at the end of the school year), in various forms and its purpose is to establish the level of knowledge and skills of learners for the relevant period by placing relevant grades. Summative assessment is formal and quantified. The results from it can be used to assess the effectiveness of learning programmes and plans, and their future development.

There is an increasing necessity of evaluation, which can assist the process of learning; evaluation that not only quantitatively measures the achieved results, but also improves the quality of education itself. That is why more and more importance is given to formative assessment. Formative assessment concerns another aspect of the educational process, namely improving the effectiveness of education. To be effective education should be changing depending on learners' needs – continuously, day to day. Formative assessment is rather informal in nature.

There are significant number of studies on effective implementation of formative assessment in primary and middle schools. In higher education the situation is quite different. There are limited number of examples of possible application of different activities, supporting formative assessment.

In the current article a study is made of the nature of formative assessment and its main features and various activities for realization are summarized. The main goal of the current work is to present activities supporting formative assessment, which are put into practice in various disciplines taught in the Department of Informatics and Mathematics, through the use of information technologies.

NATURE OF FORMATIVE ASSESSMENT

Formative assessment is an assessment, which occurs during the process of learning in order to determine the level of performance (knowledge and skills) of learners to established goals and criteria. By formative assessment information is obtained, which is used to carry out changes in learning process to

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adapt and improve the effectiveness of education.

According to Black and Wiliam formative assessment refers to all those activities undertaken by teachers, and by their students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged. Such assessment becomes 'formative assessment' when the evidence is actually used to adapt the teaching work to meet the needs of the learners (2).

Formative assessment is a part of the educational process. It occurs during and prior to the instructions. By formative assessment teachers can investigate weaknesses and strengths of learners, what they have learned and what their gaps are. This way, the learning activities can change and adjust to learners' needs to improve education (3). Consequently, the main purpose of formative assessment is to improve the learning process, rather than come up with grades of the learners.

According to Ziad Baroudi formative assessment consists of activities used by the teacher to determine the student's level of knowledge and understanding for the purpose of providing the student with feedback and planning future instruction. The feedback and future instruction may be concerned with remediation or the provision of further learning opportunities (4).

Formative assessment is defined as frequent, interactive assessments of students' progress and understanding to identify learning needs and adjust teaching appropriately (5).

KEY FEATURES OF FORMATIVE ASSESSMENT

- Formative assessment is **a part of the educational process**. By formative assessment teachers get information about the level of assimilation of the learning content by learners. Teachers interpret this information and can define the next steps according to the results achieved so far. Teachers can estimate the effectiveness of using learning activities and decide what actions are needed to assist learners in the process of achieving set goals.
- **Feedback** has a very important role in formative assessment. Through feedback learners can understand their current knowledge, become aware of any gaps that exist to their desired goals and what to do to reach their goal (6). Feedback is most beneficial when it is constructive – comments on specific errors and assumption and directions for their elimination.
- The process of formative assessment **includes the learners themselves**. They are active participants both in terms of mutual evaluation with other learners and in terms of their own evaluation. By formative assessment learners can improve their own learning – they can find out about their learning, what they have learned, what the next step is and how to reach their goals. As learners participate actively in the evaluation process and analyze results, their motivation to learn is increased (7).
- An important aspect of the implementation of formative assessment is **to set and share the learning goals (standards) with learners** in advance. They have to know what the target is and what the criteria for reaching it are. This assumes greater interest and engagement of learners in the educational process. Knowing the final goal, at any time, they can determine where they stand using different activities of formative assessment. Using teachers' feedback learners can understand where they need to be, and what they have to do to reach the target. It is necessary to share with learners the criteria of assessment – what and how will be assessed.

MODELS OF FORMATIVE ASSESSMENT

In literature there are two models of formative assessment (8-9) – **planned** (formal) and **interactive** (informal).

Planned formative assessment includes pre-planned various assessment activities by teachers to elicit information on what learners have learned from the previous lecture or exercise. By planned formative assessment teachers obtain information from the whole class on the progress of learning. The collected information is interpreted according to a pre-determined set of criteria and a judgment is made on the achievement levels of the learners. Based on the interpreted information the teachers undertake different actions according to learners' results to enhance education. This process ranges over longer period of time – a day – couple of days – a week.

Interactive formative assessment takes place during student-teacher interactions. It is not planned in advance and occurs during the educational process. Teachers are not able to plan in advance, because they cannot predict what and how learners will do. Interactive formative assessment can include only particular learners – as individuals or small groups of learners at some point in the lecture or exercise. As a result of this model of formative assessment the teachers receive information, usually verbal, analyze it and get a real idea on the level of learners' knowledge. After that they undertake appropriate and necessary actions to improve learning. This process ranges over very short period of time – the feedback should be immediate and aimed at improving the performance of learners.

Planned formative assessment includes all learners and their results are recorded. Unlike planned formative assessment, interactive formative assessment can involve only certain learners and their results are not recorded.

FEEDBACK IN FORMATIVE ASSESSMENT

Feedback is very important in the educational process. Feedback gives an idea to learners about their gaps in learning, the difference between the learning goal and their current level.

Theoretically, feedback can be viewed as any communication between the teacher and the learner that provides information about the learner's performance of an assessed task (10). By formative assessment teachers and learners receive direct and immediate feedback.
Feedback can be examined as bilateral – to the teachers and to the learners. Feedback to the teachers gives them opportunities to establish the level of learners' assimilation of the learning content and to undertake the necessary subsequent activities in order to achieve the learning targets. Feedback to the learners gives a clear idea of their own work, what they do well and what they should pay more attention to in order to improve their results (11).

To be effective feedback should be concrete and constructive. This means that it should be entirely relevant to learners' works, related to the demonstrated knowledge and skill during tasks execution. Feedback should be detailed – it should include an explanation not only why a given answer is correct or not, but also comments on strategies for reaching the correct solution. Feedback should be well balanced in terms of positive and negative remarks. An important thing is to avoid comparisons with other learners.

Feedback should be timely and contain recommendations, advice and guidance to learners regarding to corrections of concrete assignment and also regarding future work – what activities should be taken by learners to enhance their learning process.
If feedback has all these qualities and features, learners will be able to build their own model or strategy for learning.

TYPES OF FEEDBACK

Several types of feedback can be differentiated (9). Feedback can be evaluative or descriptive. Descriptive feedback is very important because it enables learners to understand what they have assimilated of the learning material and what they have to do to improve their learning.

On the other hand feedback can be individual (private) or public. Public feedback focuses on the critical elements and errors that learners make. It has a preventive effect to preserve from common mistakes. Private feedback is specifically directed and concerns skills and knowledge of particular learner. As a result, the effect of private feedback is much greater.

Feedback can be classified as oral (verbal) and written. Oral feedback is immediate. By oral feedback learners can explain why and how they came to particular solution and teachers can help them to correct any eventual errors or to turn them to the correct strategy. Written feedback is more detailed and profound.
It is very important how learners use feedback in their training. On the one hand it may lead to enhance learning and on the other it can be stimulus to increase their motivation to learn.

ACTIVITIES (STRATEGIES) THAT SUPPORT FORMATIVE ASSESSMENT

The literature describes various activities or strategies that support formative assessment (1, 12):

- **Observation**

Observation is one of the most common and long known methods of establishing the level of assimilation of the learning content. Teachers collect information based on learners' verbal and non-verbal behavior and communication with them. This information is analyzed by teachers and they undertake different activities to correct learners'

strategies of learning. The evidence from observation can be recorded in various forms and serves to monitor learners' progress over time.

- **Short questions and discussions**

Questioning strategy is one of the most commonly used strategies. Questions should be designed to reveal the full degree of learners' understanding and assimilation of the learning content, their opportunities to reflect on the study material. It is not enough to ask questions related to concrete facts and data. There is a necessity of questions that provoke deeper thinking. As a result of questioning strategy the learners are involved in a dialogue that uncovers and expands learning. The dialog can generate a discussion. A classroom discussion on the learning material discovers mental activity of learners and the depth of their knowledge. During discussions questions are open-ended and evoke a profound debate on topics. Feedback is immediate and it is difficult to be recorded.

Questioning strategies and discussions require sufficient time for learners for reflection and design of responses. A good strategy is the ability to discuss answers in pairs or in small groups and then a representative from each group shares with others their vision or solution. Frequently used approach is voting on several answers and justifying the selected response.

Questions can be asked at the beginning of the lecture to get information on what learners have understood from the previous lecture. Another way is asking questions at the end of the lecture to establish the level of learners' assimilation of the taught lesson and their ability to derive the main idea and concept. Questions can be included as a part of the process of teaching – they should be carefully planned and prepared. Questions can be related to the establishment of the learners' understanding about particular concept before and after the lesson.

Learners' ability to ask questions about learning content is very important. This is another aspect of this formative assessment strategy and leads to in-depth learning.

- **Short tests and quizzes**

Short tests and quizzes can be a part of everyday learning. They can be regarded as activities that support formative assessment when feedback to learners includes information on correct answers, on errors and ways to remediate them.

- **Assignments**

Assignments cover a wide range of activities and homework assignments performed by learners – from exactly defined tasks to tasks that require more activities – for example – searching for and investigating of information, information aggregation and comparison of different resources. By assignments teachers can monitor learners' progress. The assessment of assignments is a more complicated process and should be based on preliminary defined and shared criteria with learners.

- **Projects**

Individual or group projects are one of the activities that are increasingly expanding in modern education. Projects provide opportunities for learners to work thoroughly on more complex problems. These activities continue over a long period of time and during the length of the project, teachers can observe learners' planning, development of ideas, and their ways of thinking. Feedback can take place throughout this entire process and can be given in different ways and forms. Group projects require team work, communication between participants and can be used to develop the abilities of learners to work together.

- **Self and peer assessments**

To be able to carry out the strategy of self and peer assessment it is necessary that teachers inform learners about the goal of learning activities. It is important to set pre-defined assessment criteria and shared them with learners. Teachers comment on the assessment that learners have made in terms of their own work, and in terms of assessing other learners (their colleagues). By self-assessment learners become active participants in the educational process. Peer evaluation enables learners to look at others' assignments as sources of knowledge because they examine and assess them compared to previously established criteria.

- **Portfolio**

Portfolio is a collection of works and assignments developed by learners. Portfolio covers various activities for a long period of time. By portfolio teachers and learners can monitor the educational process, performance and achieved results, constantly cooperating with each other.

It is very important for tracking learners' progress to record their results during

education. Teachers and learners can monitor the progress they have made, starting from the initial point to final target. Thus, learners' motivation is increased because they see their results and how far they are from the learning goal.

ACTIVITIES (STRATEGIES) THAT SUPPORT FORMATIVE ASSESSMENT USING INFORMATION TECHNOLOGIES

The variety of courses, conducted at the Department of Informatics and Mathematics presumes the use of different techniques for carrying out formative assessment. Based on the specifics of the course appropriate techniques are chosen. Some of the courses allow for traditional activities (in classroom) of formative assessment. Others allow the use of information technologies to vary activities. One possible way is to use Learning Management Systems. Virtual Trakia University is built on the basis of LMS Moodle. The system offers opportunities for implementation of activities that support formative assessment.

In the next part of the current article we have presented some examples of our practice related to formative assessment.

- **Short questions and discussions**

The teacher prepares in advance short questions on the topic of the lesson in order to establish the level of learners' assimilation of the learning content. Such questions can be used to check any problems related to lack of understanding of basic concepts.

This approach is often used in Statistics and Biostatistics courses. The purpose of these short questions is to assess students' understanding of basic concepts. For example – measures of central tendency to summarize data (in the area of data analysis). We are aware of common misconceptions that students have about the concept for median.

The teacher asks well formulated short questions in order to establish whether all learners are aware of the matter. He presents two identical data sets, each with 9 terms (the number of terms is exemplary), except one set is ordered and the other is not. The question is whether the two sets have the same median value. Students think on their own and then discuss in pairs. The teacher polls the group on the question. In case of wrong answers the teacher carries out a discussion. Different groups are formed, students discuss possible answers and finally a student from each group explains why they selected that particular response. The teacher is able to identify which students have problems with tasks like that.

A different scenario is asking short questions immediately after the lecture regarding main concepts. The teacher asks students to summarize the main ideas they have taken away from the lecture.

Through activities such as short questions and discussions the teacher and the students can find out the level of understanding of main concepts. Depending on the results (students' answers) the teacher can change some of the activities to include new activities and repeat others to fill the gaps and clarify controversial points.

- **Practical tasks**

We use this activity in our Linear optimization courses. The teacher gives students practical task for solving during the exercise. At the beginning students work alone for the allotted time and then discuss their responses in pairs or small groups (3-4). The teacher circulates among the students listening to their discussions, asking questions about their work, and answering questions to clarify the task. After the allotted time, there is a class discussion about the problem. After discussing the issue, the teacher and the students construct/write an appropriate answer/model of the task.

Feedback is primarily verbal – comments on proposed solutions, questions to students why and how they have come to the answer, answers to students' questions. At the end of the "shared" part of the exercise, the teacher summarizes and comments on common mistakes that students make.

- **Short tests**

Although in most cases tests are used as a means for summative assessment at the end of a term or school year, they can also be used for self-assessment by students after lectures. **Figure 1** shows different short tests for self-assessment after lectures.

Fig. 1. Short tests after lectures.

Test questions are about main concepts and ideas, general terminology, knowledge of concrete facts, etc. Using the tests, the teacher and students assess the level of assimilation, comprehension and understanding of the learning content. The questions are multiple choice or open questions – short answer. There are two possibilities – feedback includes correct answers or not. In the latter case, students can repeat the test, because the correct answers are not given. They can analyze and revise the mistakes they have made.

Feedback in computer-based tests is immediate. Besides seeing whether they answered correctly or not, it is important for students to understand why their answer is wrong. Feedback may include advice on the way to reach the correct solution. On the other hand, feedback in cases of correct answers may contain more detailed information about the questions.

The system offers opportunities for comments on students' answers by the teacher **(Figure 2)**. The teacher can review students' attempts and comment on specific mistakes, give recommendations on the way of achieving the right solution. The students can view teacher's comments and correct their learning.

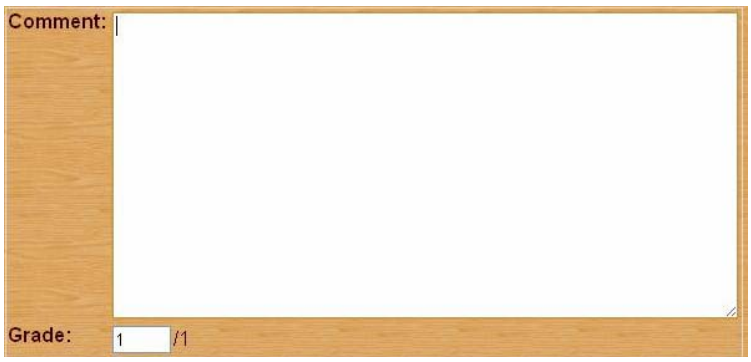

Fig. 2. Window for teacher's comments and grades.

Thus, tests not only reveal students' understanding of the learning material, but also become a means of enhancing the learning. Therefore, tests are one of the activities that support formative assessment.

The system tracks the progress of the students. There are records about every attempt and every score **(Figure 3)**. The students can compare their own results both to results achieved in previous attempts and to other students' results.

History of Responses:

#	Action	Response	Време	Чист резултат	Grade
1	Grade	ime	09:24:36 on 6/03/10	0	0
2	Grade	name	09:24:40 on 6/03/10	1	1
3	Close&Grade	name	09:24:46 on 6/03/10	1	1

Fig. 3. History of Responses.

- **Assignments**

We use these activities in Computer text processing and presentations courses and in Information systems and Internet technologies courses. Assignments are learning activities where the teacher gives specific tasks to students – for example, the task requires searching for information from different sources and evaluating it; classifying and comparing the information. Based on gathered information students draw conclusions on the problem and present them in the form of presentations. The students upload their fulfilled assignments in any format to the server **(Figure 4)**. The teacher makes comments and reviews the students' work. The comments may include remarks and guidance to students to improve their work **(Figure 5)**. Students are allowed to revise their work based on the teacher's comments and upload it again. Feedback is primarily written – comments and reviews. To allow for a constructive exchange of opinions between teacher and students they can use other means of communication provided by the system Moodle – e-mail, chat, and forum.

Fig. 4. Students' assignments and teacher's comments.

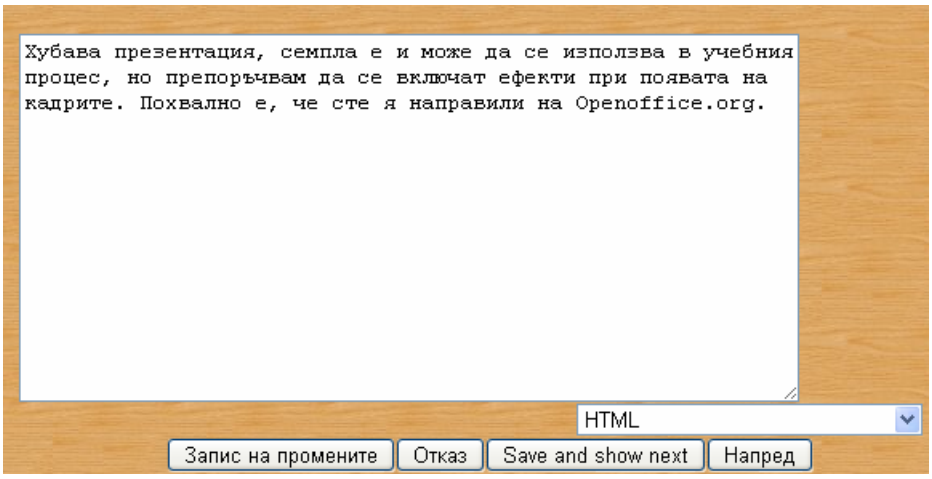

Fig. 5. Teacher's review of student's work.

- **Peer assessment**

We use these activities in Computer text processing and presentations courses. This activity is an opportunity for comments and reviews of students on a sample work, which may be given by teacher or be made by student from the course. Peer assessment can be done in a traditional way in classroom through discussions during the exercise or by using system Moodle. Moodle offers a module Workshop for activities like this. The use of this module presumes more detailed, thorough and well-founded reviews because they are in writing and can be commented on by each student in the group.

Once the task is given (for example – a review of a sample presentation, which is given by the teacher) it is necessary to be discussed and established criteria on which the peer assessment will be based. Criteria may vary in the degree of complexity. As a start they may concern indication of errors and inaccuracies in the presentation. Subsequently, the criteria may affect the indication of strengths and weaknesses of the work and after that they deepen to give critical comments and directions for improving work.

The students need to provide reasons for their comments **(Figure 6)**.

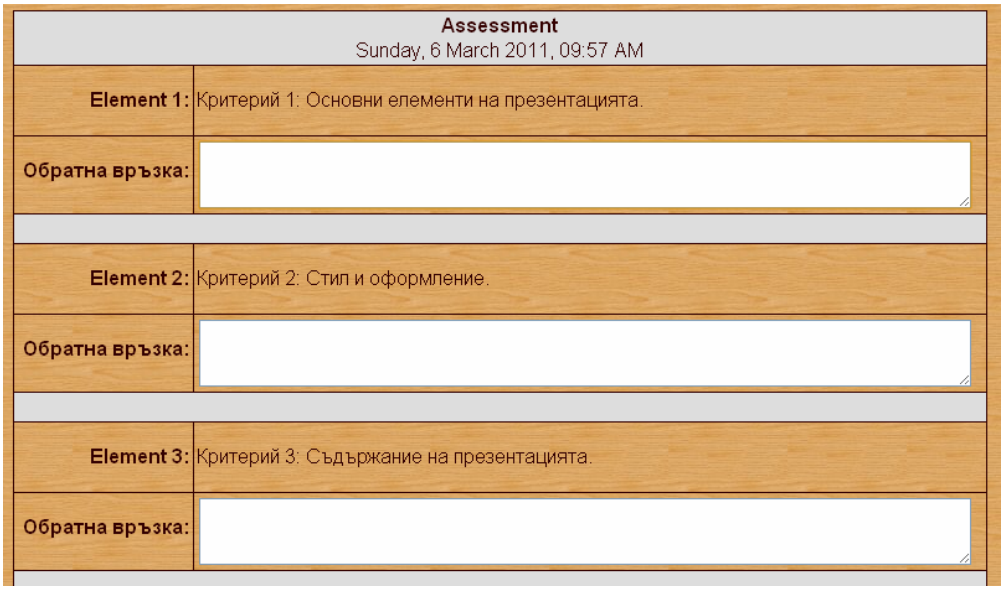

Fig. 6. Students' reviews and comments on a sample presentation.

The teacher also comments on students' reviews **(Figure 7).**

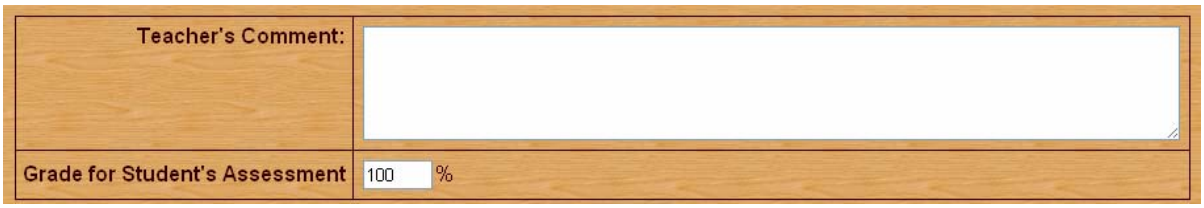

Fig. 7. Teacher's comments on students' reviews.

By peer assessment activity it is possible to reveal the level of students' knowledge, their ability to give reasons for their opinions based on knowledge and skills they have and to identify ways to correct errors.

- **Group projects**

We use these activities in Communication and information systems courses. The group project is related to gathering and presenting information about particular topic of the learning content. The students create a Web-site by the system MediaWiki **(Figure 8)**. Web-site is the final presentation of the project. The new versions of Moodle have a module Moodle Wiki. The intent is to allow for the group projects to become a part of the system Moodle. Each student in the group works on separate item of the project and publishes his results. Other students in the project can correct, edit and add new information. The students work together as a team, add, expand or change the published content. All these activities include peer assessment, even if in a less direct way. Students may consult with the teacher. He helps and guides them in their work to correct some inaccuracies. Communication between them is verbal or written. The system Moodle provides means for e-mail, chat, forum and feedback is immediate and in real time.

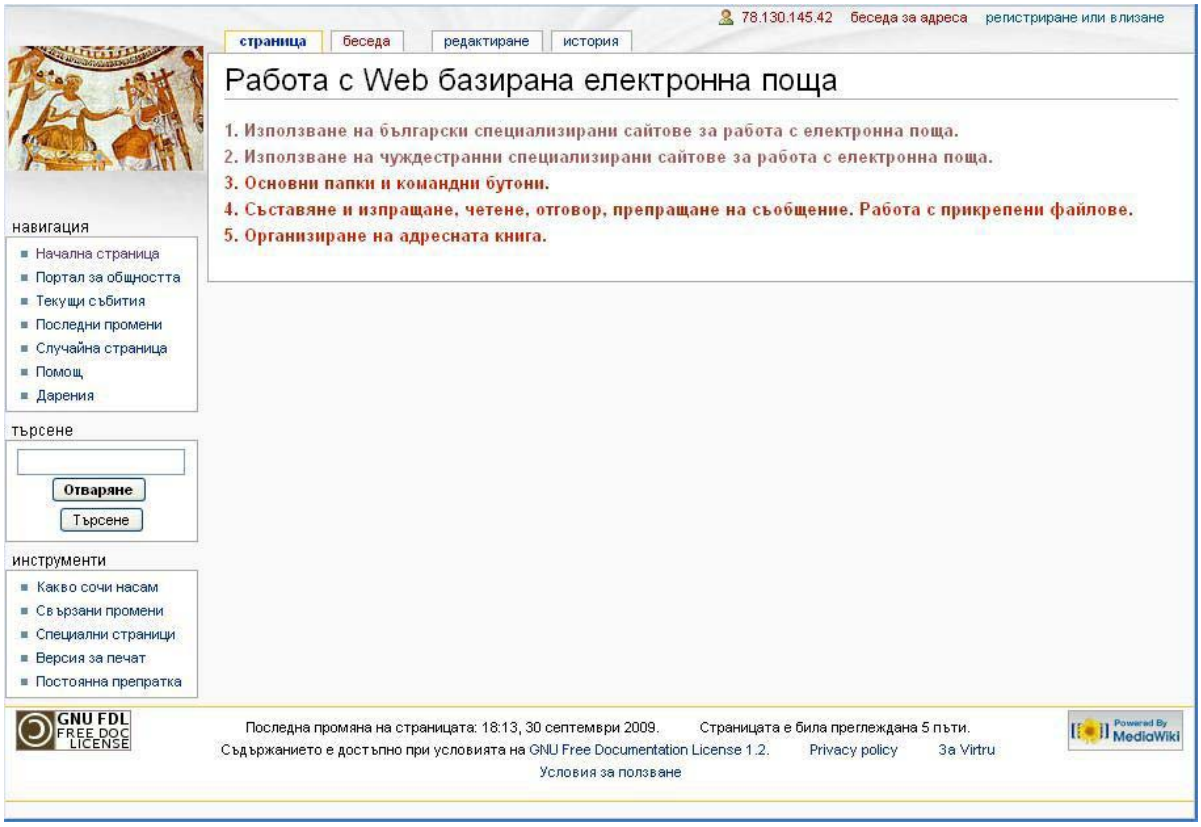

Fig. 8. Group project in MediaWiki.

FUTURE GOALS AND TASKS

The development of the learning management systems provides various tools for the implementation of formative assessment.

A portfolio is a new approach in our educational system. Our main goal is to implement this activity and use it for formative assessment. This goal requires realization of several concrete tasks: investigation of the essential opportunities and characteristics of the portfolios and how this activity could improve our work. The next step is to implement the portfolio in our practical work through installation and setting-up of Moodle modules, development of specific tasks and their implementation in the educational process. After that we can do research and analyses of how the e-portfolio enhances the effectiveness of education, how we can assess formatively and last but not least how students perceive this new educational approach.

CONCLUSION

The introduction of new information and communication technologies in education offers opportunities for diversification of techniques and activities used by teachers in the learning process. This inevitably has an impact on the assessment. Attention is paid to the implementation of formative assessment to assist the learning process, to improve the quality of education and to enhance learners' motivation. From our practice, we can conclude that by using our learning management system we have both traditional means for summative assessment and various activities that support formative assessment. As a result of implementation of the activities that support formative assessment there is heightened interest and responsibility for the learning process by learners. This obviously leads to improvement of the process of teaching and learning and enhances the overall quality of education.

REFERENCES

1. Marshall, J., Formative Assessment: Mapping the Road to Success A White Paper Prepared for the Princeton Review, July 2005.
2. Black, P., D. Wiliam, Inside the Black Box: Raising Standards Through Classroom Assessment, November 2001.
3. http://en.wikipedia.org/wiki/Formative_assessment (last access 03.04.2010).
4. Baroudi, Z., Formative Assessment: Definition, Elements and Role in Instructional Practice, Post-Script: Postgraduate Journal of Education Research, Vol. 8(1), August 2007, pp. 37-48, http://www.edfac.unimelb.edu.au/research/resources/student_res/postscriptfiles/vol8/Ziad_Baroudi.pdf (last access 03.04.2010).
5. Formative assessment – improving learning in secondary classrooms, http://www.oecd.org/dataoecd/32/0/34221065.pdf (last access 03.04.2010).
6. Boston, C., The Concept of Formative Assessment, ERIC Clearinghouse on Assessment and Evaluation, http://pareonline.net/getvn.asp?v=8&n=9 http://www.ericdigests.org/2003-3/concept.htm (last access 03.04.2010).
7. Bell, B., B. Cowie, The Characteristics of Formative Assessment in Science Education School of Education, New Zealand, September 2000, http://www.d.umn.edu/~bmunson/Courses/Educ5560/readings/BellSciEd01-85-536.pdf (last access 03.04.2010).
8. Carless, D., Pre-emptive formative assessment, 2006, http://www.iaea2006.seab.gov.sg/conference/download/papers/Pre-emptive%20formative%20assessment.pdf (last access 03.04.2010).
9. Lo, Yiu Chun, Practice and Challenges of School-based Formative Assessment, 2006, http://www.iaea2006.seab.gov.sg/conference/download/papers/Practice%20and%20challenges%20of%20school-based%20formative%20assessment.pdf (last access 03.04.2010).
10. McDonnell, M., Formative Feedback and Learning in the English Classroom, 2007.
11. Paterson, K., Good practice for formative assessment and feedback in statistics courses, 2009, http://theses.gla.ac.uk/623/ (last access 03.04.2010).
12. Garrison, C., M. Ehringhaus, Formative and Summative Assessments in the Classroom, http://www.nmsa.org/portals/0/pdf/publications/Web_Exclusive/Formative_Summative_Assessment.pdf (last access 03.04.2010).