

Development of critical thinking in mathematics courses

Tatyana Oleinik, Skovoroda Pedagogical University, Ukraine

This paper represents the results of our research on critical thinking development for students (pre-service teachers) of physics and mathematics faculty in realising International Project on Reading and Writing for development of Critical Thinking (RWCT). We discuss on special courses to undergraduate students of «mathematics-computer science» speciality. But now our educational system is in state of constant search of ways for its development. It is evident that the problem of training mathematics teachers now demands special attention. How are they to be trained for the problems they will encounter in everyday practice? How can they be helped to overcome upsettedness and inertia in which most teachers are now? We start to talk about democratic transformations in education and person/child centered study. So we discuss on Ukrainian “face” of its project realization (it consists of the best traditions of Soviet pedagogical school). Among the peculiarities of the project implementation in our University there was an attempt to develop critical thinking by mathematical subjects and technology.

The main goal of our courses to change the level of a personality’s social defence: only a widely educated person with SOFT SKILLS is able to flexibly restructure the direction and essence of his/her activity. It means that people become to be able to make comprehensive and deep analysis of new information, to formulate original ideas, to select rationally from competing ideas, to solve non-standard problems, to have a constructive dialogue with partners, to orient towards self-diagnosis in respect to the degree of formation of different skills by comparing one's own results with outlet standards, etc.

The realization of project promotes democratize an education by changes in a teaching of methodology of disciplines which study. The project offers a of precise system of educational techniques which will promote pupil's development of critical thinking and skills of independent training. We consider the following basic points for the definition of critical thinking (Cluster, 2001): (1) critical thinking is independent thinking and social thinking; (2) information is the starting point for critical thinking, not the final point; (3) critical thinking begins with questions, with problems to be solved; (4) critical thinking seeks for reasonable arguments.

Our opinion is that critical thinking technology (CTT) has to be one of the leading modern technologies and its adaptation in the Scovoroda Pedagogical University should promote constructive discussion concerning the utilization of

peculiarities of Ukrainian scientific-pedagogical school for the training of competitive and professionally self-oriented teachers.

The RWCT (Steel, Meredith, et al., 1998) project has set some general expectations for the educators participating in the project. The expectations towards participants at the end of the project are: a) to be master teachers, able to serve as instructional models and resource people within their own professional setting, i.e. school, university, methods center, etc.; b) to conduct staff development workshops for other faculty who do not have access to the same intensive staff development.

Further, by implementing the program in their own professional setting they gain credibility as experts. Thus, the goals of the RWCT project are: a) to develop open, collaborative, collegial, long term relations between educators from various cultures and circumstances which will expand the understanding of teaching and learning for all children and lead to a free flow of ideas between peoples; b) to increase the capacity of students to think critically, engage in critical reflection, take responsibility for their own learning, form independent opinions, and show respect for the opinions of others; c) to present practical methods of teaching based on philosophically consistent and theoretically sound ideas; d) to place teaching within a comprehensive instructional framework which guides instructional decision-making; e) to empower faculty to take responsibility for becoming model teachers of RWCT able to reflect on students' thinking and learning and refine methods based upon those reflections; f) to engender participant confidence based on successful implementation of the program in their own educational setting; g) to prepare participants to deliver the program to their peers.

We have been convinced that IT is an effective intellectual tool in the development of educational technologies in compliance with the cooperative learning and collaborative work. It's mainly due to the fact that IT enables the user to orient in the endless "sea" of constantly changing and updating information.

Learning projects are more oriented towards practice as compared with the tasks of traditional school curriculum, namely: firstly, their description part is very different (story, diagrams, calculations, etc.). Secondly, projects should have an immediate practical value (searching work efficiency improving methods, predicting product outputs and costs). Project implementation! key is getting an actual result, i. e. when solving theoretical problem it should be concrete solution of the problem; when solving practical task it should produce a concrete result-Thirdly final and known data should, be real ones, taken from live situations which therefore require integrated knowledge (knowledge of different subjects, fields of science, technologies, cultures).

We developed the methodology (based on the CTT appropriate provisions) for carrying out students' projects with the application of economical content tasks for senior school and 1st year university students. The main purpose of these developments is to improve educational process by deep learning to ensure

mathematical disciplines and formation of practical abilities to use them at practice.

In the specialized training course a big attention is paid to the introduction of metacognitive processes, i.e. mastering of "thinking strategies", "implementation rules" for cognitive actions since, if they are ignored, it leads to the formation of false and formal views and conceptions. In this context it is important to overcome stereotypes as for the "right" and "wrong" responses. We are sure that the students, who mastered the CTT are interested in listening to different opinions of their colleagues; they understand the importance of joined searching and development of more argumentative status of their ideas, making such an environment in the classroom that favors free accepting or argumentative rejecting of views of the others (Cluster, 2001).

While developing projects students are working individually and in groups, they are solving different tasks connected with the application of knowledge from the different field of science; they are organizing brainstorming, expert group meetings, learning how to use and utilize IT in their projects. Our experience shows that such a training allows the teacher to solve effectively the problem of choosing training objectives, developing training plans, designing a system of lessons, etc., thereby motivating the development of elements situational pedagogy and situational methods which have to be created by the teacher each time anew, depending on the training situation which appear due to specific features of both the student and the teacher, their creative potential, talent for improvisation, etc.

Depending on the difficulties and type of mistakes made by students, the teacher can use CAS and dynamic geometry software in order to encourage the students to follow their interests, to reflect, to pursue the principle self-determination (analysis of the created situation, reflection upon the performed actions, selection of optimal implementation methods), and to train cognitive methods and their application to particular situation (formation of questions, contradictions, generalizations, search for analogues, etc.). – I'm sure that all project participants will agree that RWCT project was favourable to a training environment featuring, first of all, orientation to investigation, democratic style of communication, the development of self-reflection and the ability to understand each other.

Our belief in the feasibility of such developments is grounded on the peculiarities on the training process which allows to solve a basically new didactic problem, i.e. to study local or global phenomena and processes in complex systems on the basis of modeling. Obviously it is necessary to modify curricula and the methodical framework which should focus to formation successful learners.

References

- Cluster, D. (2001): What is the critical thinking? *Critical Thinking*, p.36-39
- Steel, J., Meredith, K. et al. (1998): A Framework for Reading and Writing for Critical Thinking Across the Curriculum. Guidebooks I-VIII. Kyiv (in Ukrainian)