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Improve critical thinking skills for students of FTT – Yambol

Nedeva Veselina[1], Dineva Snejana[2]

(1) Trakia University, Faculty of Technics and Technologies, Department Electrical Engineering, Electronics and Automation, Yambol, Bulgaria;
E-mail: veselina.nedeva[at]trakia-uni.bg
(2) Trakia University, Faculty of Technics and Technologies, Food Technology, Yambol, Bulgaria; E-mail: snezhana.dineva[at]trakia-uni.bg

Abstract

Critical thinking is an important skill, especially in the digital century, when a huge amount of information bomb the young, every day, through the web net. The aim of the paper is to describe and introduce the main qualities of critical thinking. We present also how the abilities of well-developed VLE help for the successful growth of students. The good practices that we use to boost critical thinking are discussed. We try to develop critical thinking and logical reasoning skills. These are our main goals in teaching programming. Programming is a complex process where the programmer very often uses most of their time to planning the individual pieces that will come together to make the system works. In the paper, we analyze different strategies that we apply to improve critical thinking: training strategies; strategies for ongoing knowledge testing; evaluation strategies. Each of these aims to develop critical thinking along with mastering programming languages. Implemented strategies in programming training produce positive results, allowing students to grow professionally.

Keywords: e-learning, critical thinking, good practices

1 Introduction

Programming training is part of the curriculum of most of the specialties at Faculty of Technics and Technologies (FTT) - Yambol. Professional programming skills require a variety of skills, including critical thinking is the greatest assets. Critical thinking training is not like learning a programming language. Instead, critical thinking is a soft skill that is cultivated over time, not just by learning about concepts and listening to lessons. Learning to develop critical thinking and logical reasoning skills are our main goals in teaching programming. Programming is an enough complex process where the programmer very often uses most of their time to planning out the individual pieces that will come together to make the system works.

Thinking critically comprise many traits, but one of the most important quality is thinking independently, which is much more of just thinking clearly or rationally (Wabisabi Learning, 2019). Critical thinking is the ability to analyze and evaluate information (Duron et al, 2006). In the last decade, more and more students are conducting academic research on-line, so for them, it is essential to have well developed critical thinking (Browne *et al*, 2000).

We need then an "ability to analyze and evaluate information", to "raise vital questions and problems, formulate them clearly, gather and assess relevant information, use abstract ideas, think open-mindedly, and communicate effectively with others" (Duron, Limbach, & Waugh, 2006, p. 160).

The aim of the paper is to present the abilities of well-developed VLE of Trakia University – Stara Zagora (http://edu.uni-sz.bg/?lang=en) and the good practices for strategies that are applied for successful development of critical thinking of learners.

2 The base of critical thinking

The critical thinking skill is crucial for the decision-making process and for gaining constructive results, the reason is hidden its nature (fig.1).

Figure 1. The stages of the decision making process of critical thinkers

People who think critically are classified as instinctual problem solvers (Skills You Need, 2017). The important peculiarity of a critical thinking is to clarify the goals and then to start decision making process, based on a different possibilities. On the fig.1 are summarized the main stages of a decision making process, when the critical thinking is applied (Skills You Need, 2017). When receive information to ask yourself: "*Who said it?*" – is it matter to you; did you know that person; is it person in a position of authority or power. The next question that will follow: "*What did they say?*" – is it all the facts or opinions and what they left out. After that to clarify "*Where did they say it?*" - in a public or in private place; is the other people have the same chance to respond and provide an alternative account to. The important question is: "*When did they say it?*" - before, during, or after an important event. "*Why did they say it?*" – to see the reasoning behind their opinion; may be trying to make someone look good or bad. And last but not least: "*How did they say it?*" - happy or sad, angry or indifferent; write it or say it; could you understand what was said.

The characteristics typical for critical thinkers included (Skills You Need, 2017):

- ✓ *Curiosity* – the critical thinkers are lifelong learners, which have broad interests and curiosity about the world and people, with a philosophical understanding and appreciation for a diversity of cultures, beliefs, and opinions of a great critical thinkers.
- ✓ *Compassion* – that means no judgment and segregation during a decision making process, combining an emotional, instinctual and intellectual sides of the action.
- ✓ *Awareness* – the critical thinkers desire constructive outcomes by not accepting anything at face value, appreciating facts hiding in everything, asking questions (fig.1), and exploring all sides of an issue.
- ✓ *Decisiveness* - directly linked to the quick and decisive action, instead of not making any decision at all; to move things forward rather than backward or postponing; thinking critically means to weigh all options, put aside fear and making decisions with confidence, even when the information is not all that are need it.
- ✓ *Honesty* - resides at the core in any sense, and it is very important especially for critical thinking. Moral integrity, ethical consideration, global citizenship practices, a strong desire for harmony and fulfilment are all part of effective critical thinking. Critical thinkers are aware, accepting of themselves as they are of others.

- ✓ *Willingness* - open-mindedly, constantly improving, learning from their own personal mistakes and shortcomings, and excelling; challenging the status-quo when the need arises; listening actively rather than simply waiting for their turn to talk;
- ✓ *Creativity* - effective critical thinkers are also largely creative thinkers, usually in the collaborative modern workforce. Creativity has indisputably defined itself as a requisite skill for having. For instance, get creative with products and how they are advertised, means thrive in the global marketplace.
- ✓ *Perseverance* - staying on task, not give up until a solution is formulated, a process is determined, or a decision is reached; critical thinkers tend to model by default; an especially useful quality not only to have but to be able to encourage in a team-working environment.
- ✓ *Objectivity* – not to be affected by external or internal influences, such as burst of emotions; base on the facts that included all points of view and concern; to appears mature and rational; full acceptance and consideration of possibilities;
- ✓ *Reflective capacity* **-** a critical thinkers accepted their mistakes, learn, internalize, and move on to the next challenge.

The person with well-developed critical thinking easy understand links between ideas, appraise arguments, identify errors and irregularities, determine the importance and relevance of arguments, approach problems (Skills You Need, 2017).

3 Good teaching practices to encourage critical thinking

Good teaching practices are summarized and explains in a 5-step process for boosting critical thinking (Agoos 2019; fig.2). On the first stage – *formulate question.* After knowing for what you are looking for – *gather information.* Check the reliability of information – *apply the information*. Hence, followed comparing of your point of view with the other or – *explore other points of view*. On the end of that process comes – *consider the implications (*fig.2*).*

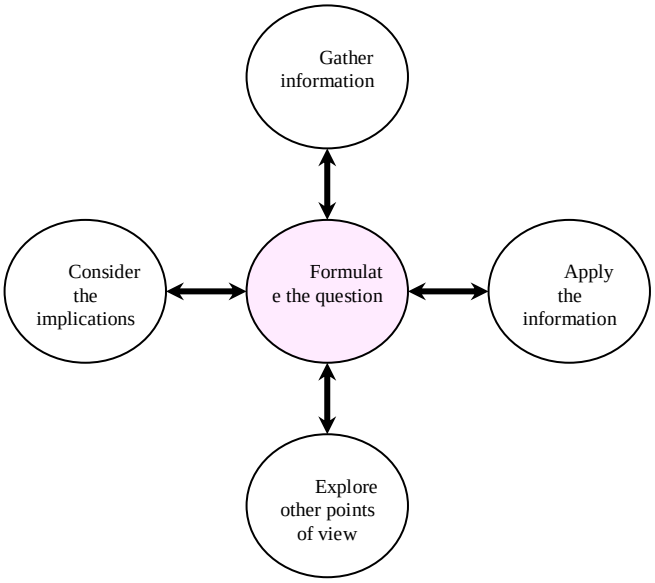

Figure 2. Boosting critical thinking (Agoos, 2019)

Another lessons model for enhance critical thinking, also in 5-step framework is given on fig.3. The process can be applied in almost any teaching or training situation, and effectively move learners toward critical thinking (Duron *et al*, 2006).

The 12 solid strategies, discussed on the blog web page of Wabisabi Learning (2019), for teaching critical thinking skills are:

- *Begin with a question* - it should be a quest for knowledge and problem-solving; encourage brainstorming; have an open discussions with students; write down possible answers on a chalkboard or student answers;
- *Create a foundation* – no one can think critically without proper information. So related data which ensures that recall facts pertinent to the topic at the beginning of any lesson. These may stem from things like: *reading assignments and other homework; previous lessons or exercises; a video or text;*
- *Consult the classics* – the classical information is always the most reliable and the best basis to launch for exploring great thinking.
- *Creating a country* - maybe a tremendous project-based learning scenario about learning. In the process, students can learn history, geography, politics, and more.
- *Use information fluency* - mastering proper information is crucial, it's about how to dig through knowledge to catch the most useful and suitable facts for solving a problem.
- *Utilize peer groups* - digital natives thrive in environments involving teamwork and collaboration, their peers are an excellent source of information, questions, and problem-solving techniques.

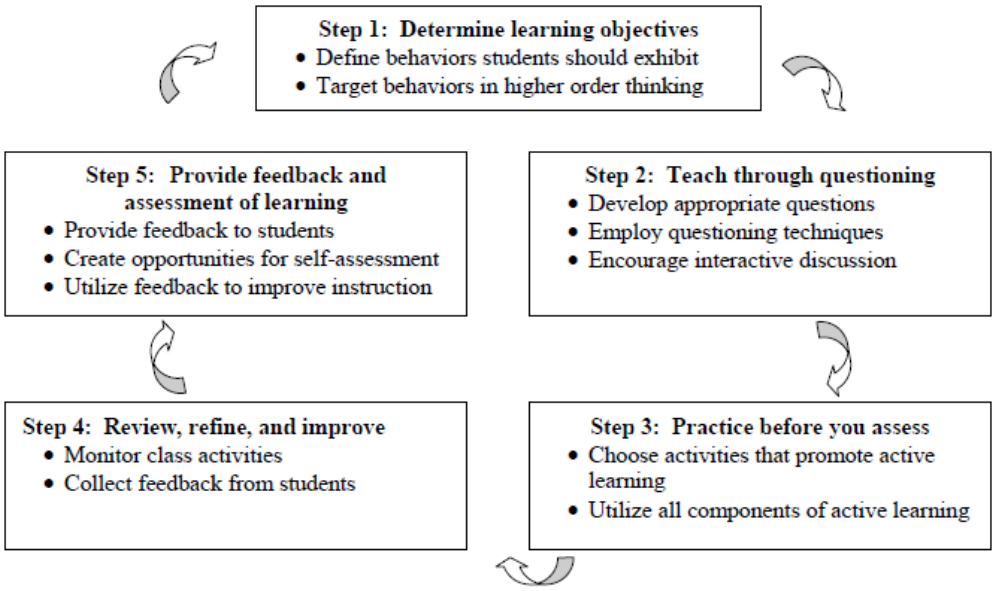

Figure 3. 5-step model to move students toward critical thinking

- *Try one sentence* – that is exercise: form groups of 8-10 students, instruct each student to write one sentence shapes a topic on a piece of paper. The student then passes the paper to the next student who adds their understanding of the next step in a single sentence. So, students learn to apply their knowledge and logic to explaining themselves as clearly as possible.

- *Problem-solving* – specifying a precise problem is the best path for exercise critical thinking. Leave the goal or "answer" open-ended for the broadest possible approach. This is the essence of asking essential questions requiring the discovery and synthesis of knowledge through critical thinking.
- *Return to role playing* - Role-playing has always been an excellent method for exercising critical thinking. It's why actors do tireless research for their roles as it involves inhabiting another persona and its characteristics. Becoming someone else calls upon stretching both your analytical and creative mind. Pair students up and have them research a conflict involving an interaction between two famous historical figures. Then lead them to decide which character they each choose to play. They'll each have different points of view in this conflict. Have them discuss it until they can mutually explain the other's point of view. Their final challenge will be to each suggest a compromise.
- *Speaking with sketch* - it is challenging to communicate without words and very effectively especially for visual learners. Nevertheless, converting thoughts to picture inspires critical thinking and manage learners to think using a different mental skill set.
- *Prioritize it* - every subject offers opportunities for critical thinking, and should be apply always in your lessons; check to understand and discusse; accept the critical thinking as a culture rather than just an activity.
- *Change misconceptions* - critical thinking involves concentration and intensive work. Apart from correcting errors or assumptions, offer more vibrant lessons, more in-depth investigation, and better lifelong learning.

4 Developing critical thinking in FTT-Yambol

Students of FTT-Yambol have opportunity to demonstrate novel scientific information on the different topics, as well as to take course project or chore. Usually, a topic is chosen from the beginning of the semester and cover the subject area of study. After their performance, in front of auditory, usually followed a discussion, and on the end assessment from their classmates. During that discussions students learn how to present and defend their opinion, appreciating other viewpoints. Active learning makes the course more enjoyable and most importantly cause students to think critically (Duron *et al*, 2006).

Another way of developing that skill is including the students in scientific projects also. As a part of scientific projects, students learn to measure, obtain data, analyze and extrapolate the results. As a crucial part of critical thinking is the confidence to analyse, see the connections between ideas, appreciating other viewpoints and opinions (Wabisabi Learning, 2019).

During programming training, we apply different strategies to improve critical thinking: training strategies; strategies for ongoing knowledge testing; evaluation strategies. Each of these aims to develop critical thinking along with mastering programming languages.

Training strategies. The purpose of training strategies is to engage students in active learning, not to be taught only mechanically to memorize the material taught. The basic theoretical concepts in the field of programming are an exception. They have the opportunity to ask their questions during the lectures. The teacher, in turn, asks questions that arouse their attention and engages their thinking, incl. stimulating critical thinking. Students should not take the learning material for granted, but should consciously participate in the training. To this end, the Flipped Classroom approach is also applied. The major design principles of this flipped instructional approach were: self- and co-regulated, recorded small-group discussions without the presence of the instructor; flipped role of the instructor and students; and the use of video-chat technology, video camera, and Dropbox, to enable learning. This particular instructor experimented with radical student-directed learning with the instructor absent. Students were given prompts and role-playing scenarios that

guided the small-group discussions, which students then had to edit and record for the instructor [M. Jenkins, R.Bokosmaty, 2017].

A strategy for ongoing knowledge testing. The purpose of these strategies is to encourage critical thinking by questioning the process of thinking through effective techniques for preparing questions or guiding the process of thinking.

Tests with questions that require not only memorization but also the application of critical thinking skills. In this case, they are required to read the program code and answer correctly and precisely what the result would be if the compiler were executed. "An automated method is proposed to increase the number of questions in the bank by creating a plugin in the Moodle" by our colleagues. This plugin "has been developed to create a new type of test questions called Multiple Choice Multivariant Questions. By using it, an automatic increase in the total number of questions in the bank is achieved. The goal is to reduce some students' attempts to mechanically memorize questions and correct answers, and to hinder the use of unregulated help materials" [Pehlivanova, T. I., Kanchev, K.T., 2018a, 2018b].

Discuss the questions for which there are at least the correct answers and propose a new wording of the questions when testing this Quiz. This is an approach that aims to stimulate critical thinking and activate creative thinking to refresh questions that more than 90% of students have not answered.

Programming questions, part of a programming task. The newest type of questions we apply in programming training require code to be written directly into the browser, among which it is executed on a sandbox server and the student receives points. Under the "All or nothing" option, they are not eligible for a second attempt. There is an option that takes 10% to 20% or more of the points on the subject when performing multiple attempts. Tests can also be solved in adaptive mode, in which feedback is displayed if the answer is incorrect. The code verification is prepared by the case test teacher with case test inputs and outputs, some of which are visible to students, but there are others that are hidden. These types of questions are called the CodeRunner type and are provided in the Moodle virtual learning environment by installing the CodeRunner plugin.

Evaluation strategies. We apply peer-reviewing in specific disciplines. Assessing the work of their colleagues as well as participating in team projects also greatly enhances students' critical thinking skills. This is practiced in the subject of Multimedia for Web-Based E-Learning, where students design their own site and work on a specific topic collectively as activities in the virtual learning environment: audio, video, animation, vocabulary and others.

But knowing the learning goals is not enough when assessing for learning. Students must be aware also of the criteria for assessment, the standards they are aiming for. That means that apart for knowing the expected behaviors they should recognize the expected level of achievement of performance. As a result of this students become more autonomous and capable of assessing themselves or/and even other students (Fink, 2003; Hernández, 2010).

5 Conclusions

Students effectively involved in the learning process, by cooperation in the projects, seminar discussions, course assignment or presentations develop proper self-assessment, confidence, and critical thinking. Implemented strategies in programming training produce positive results, allowing students to grow professionally. The acquired skills are useful not only in their direct activity but also in real life. Critical thinking enables them to screen out false news and not spread it. They might consider trusting the high popularity of some individuals, even politically active ones when they have little evidence of their qualities. Possessing critical thinking, students can sift through scientific and pseudo-scientific facts.

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