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Teaching critical thinking to engineering students through reading profession-oriented texts

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Abstract. Nowadays critical thinking is considered to be an essential learning outcome. To be able to use it in our life it is vital to obtain this skill through studying at school and university. In this paper there are some methods considered to drill this skill through reading within a translation course.

Key words. Engineering students, critical thinking, method, profession-oriented text, translation.

1. Introduction

Nowadays critical thinking plays a vital role in a teaching process. By critical thinking we mean the mode of thinking — about any subject, content, or problem — in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing, and reconstructing it. Critical thinking is self-directed, self-disciplined, self-monitored, and self-corrective thinking. It presupposes assent to rigorous standards of excellence and mindful command of their use. It entails effective communication and problem-solving abilities, as well as a commitment to overcome our native egocentrism and sociocentrism. Critical thinking development in a teaching process is considered to be an important element in the whole study process as it allows to teach students to be able to analyze, assess and judge carefully, to provide an extraordinary method in task completion and to be adaptable to various unexpected situations in their studies, personal life and also in the professional area in the future.

2. Critical thinking for engineering students

Critical thinking for engineering students, future engineers, is supposed to be more important as these specialists work in the areas of telecommunication, information and communication technologies, mechatronics and robotics, physics, machine building and other engineering areas which require accuracy and fidelity, clearness of actions, practical thinking, attentiveness and systematization. They all come from the ability to think critically to provide a reasonable argument and show a high level of professionalism. Consequently, it is crucial to introduce critical thinking activities in a study process and drill those skills within all courses given in the program starting with humanities and finishing with profession-oriented ones.

To analyze importance of critical thinking for engineering students and put it into teaching practice we should specify the definition of critical thinking from an engineer's prospective. According to Scriven (n.d.) critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief



and action. Taking this definition into account educators can design lesson plans, study programs and, globally, curricula with the focus on engineering students' critical thinking development.

3. Modern technologies in teaching critical thinking

Realizing how important critical thinking development is it is obvious that modern pedagogy must focus on it and dedicate an essential part of the whole study process to it. There is a wide range of methods and approaches which could be used for developing this kind of thinking. However, teachers should choose appropriate ones for a certain target audience depending on such factors as age, specialization, experience and practices.

This paper aimed at paving the ways to make engineering students achieve critical thinking skills through reading profession-oriented texts. Critical thinking and critical reading are closely connected with each other as critical reading is a form of language analysis that does not take the given text at face value, but involves deeper examination of the gist and details revealing that gist. It also provides the basis for thinking that leads to developing critical thinking skills.

Consequently, to develop critical thinking through reading we should choose a set of methods or approaches which could be tailored especially to engineering students paying attention to their characteristics mentioned above. Upon previous observations and researched done at the Siberian State Aerospace University (Krasnoyarsk, Russia) it was found out that engineering students work a lot with technical texts from course books which are rather challenging to be understood through traditional skimming. Moreover, the majority of engineering students study in the additional program named "Translation in the Professional Area". This program implies to provide translation skills and strategies to engineering students to be able to translate from Russian into English and from English into Russian in their professional area. To provide the engineering material through technical texts both in their main studies and additional ones it is crucial to choose methods or approaches which could help realize the idea of the context through critical thinking development. Below there are some methods and approaches selected which are suitable for engineering students and their specific of a study process.

"Know, want to know, learned (KWL)" method

KWL (Ogle, 1986) is an instructional reading strategy that is used to guide students through a text. Students begin by brainstorming everything they know about a topic. This information is recorded in the first column of a KWL chart. Students then generate a list of questions about what they want to know about the topic. These questions are listed in the second column of the chart. During or after reading, students answer the questions that are in the second column. This new information that they have learned is recorded in the third column of the KWL chart. In case the students got unanswered questions it is necessary to motivate them to find those answers themselves as their homework and present them next lesson.

The KWL strategy serves several purposes. It allows to elicit students' prior knowledge of the topic of the text, sets a purpose for reading and also helps students to monitor their comprehension in a proper way.

"Fishbone" method

Fishbone Diagrams (Ishikawa, 1943) (also known as Ishikawa Diagrams) can be used to answer the following questions that commonly arise in problem solving: What are the potential root causes of a problem? What category of process inputs represents the greatest source of variability in the process output?

Dr. Kaoru Ishikawa developed the “Fishbone Diagram” at the University of Tokyo in 1943. Hence the Fishbone Diagram is frequently referred to as an “Ishikawa Diagram”. Another name for this diagram is the “Cause & Effect” or CE diagram. A completed Fishbone diagram includes a central “spine” and several branches reminiscent of a fish skeleton. This diagram is used in process improvement methods to identify all of the contributing root causes likely to be causing a problem. The Fishbone chart is an initial step in the screening process. After identifying potential root cause(s), further testing will be necessary to confirm the true root cause(s). This methodology can be used on any type of problem, and can be tailored by the user to fit the circumstances. In our case our user will be an engineering student who is going to develop critical thinking abilities through reading texts in the professional area.

Abovementioned methods were chosen to be the most effective methods for teaching engineering students through reading in terms of developing their critical thinking.

4. Experiment

The experiment on selecting the most suitable methods for engineering students was undertaken at the premises of the Reshetnev Siberian State Aerospace University (Krasnoyarsk, Russian Federation) in the frame of the course “Profession-Oriented Translation”.

The experiment started with providing engineering students with profession-oriented texts which supposed to teach engineering students to translate such texts. However, it was important to teach them translate texts through prompt understanding of the gist and details to provide accurate translation. It was possible to implement it only through critical thinking. To check which methods better suit engineering students each lesson was dedicated to one method on critical thinking development through reading. They are “The basket of ideas”, “False/true statements”, “Cinquain poems”, “Know, want to know, learnt (KWL)”, “Fishbone”. In total there were 5 lessons arranged. After each lesson the instructor made a survey on how much students understood after text analysis before starting to translate it. The second step was to check translation accuracy.

At the end of the set of lessons it became obvious that KWL and “Fishbone” methods and approaches work more efficiently with reference to provided translations as translations were closer to the original texts, gists and ideas were more accurately conveyed comparing to other methods and approaches.

5. Conclusion

Following the findings of the paper, it should be mentioned that curriculum developers, material designers, language and translation teachers are highly recommended to employ profession-oriented texts to help students achieve critical thinking skills and at the same time improve reading profession-oriented texts for better understanding and, consequently, prompt translation, though the results of this paper are not conclusive and more research studies are required in this regard.

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