Developing Future Pilots' Critical Thinking Skills in the Framework of Aviation English

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Abstract: *The demands on future aviation specialists working in extreme conditions to solve problems efficiently emphasize the need to use new approaches in their professional training. Although it is crucial to focus on the training of pilot judgmental skills, there is a serious lack of research in this area. This article will define the effect of teaching critical thinking skills to student pilots in the framework of Aviation English. 42 first year student pilots took part in the study, divided into a control group and an experimental group of equal numbers. Those participating in this study were chosen based on their level of English proficiency and critical thinking skills, age, and gender. In both groups the same content of Aviation English material which corresponded fully to the syllabus was taught. In the experimental group the teacher focused on developing critical thinking skills through special techniques in addition to the Aviation English material. The findings of this study show that focusing on the teaching of critical thinking skills in the experimental group resulted in a significant increase in their scores on the critical thinking questionnaire as compared to the control group.*

Keywords: *critical thinking skills; Aviation English; future pilots; critical thinking techniques; professional training.*

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1. Introduction

Globalization and competitiveness in education have certain demands on the training of future specialists where only focusing on professional knowledge and skills is not enough. The focus needs to be on high quality specialists' training which presupposes working not only under standard conditions, but also solving professional problems. In the era of computer technologies and rapid scientific-technological advances critical thinking skills are of the utmost importance.

All educators now understand the crucial role of developing learners' critical thinking skills. The researchers (Scriven & Paul, 1987) view critical thinking skills as involving a series of cognitive skills such as defining, analyzing, synthesizing, evaluating information, etc. Chaffee (1992), in his works, emphasizes the significance of teaching critical thinking. It is evident for him that critical thinking skills, such as problem-solving, coming up with ideas and sorting them out, evaluating arguments, viewing a problem from different perspectives, presenting your ideas logically and in a systemized way are the foundation of successful academic study and career goals achievement. He notices that in spite of the fact that some teachers are eager to teach their learners to think, it is not done systematically and globally in the process of learning.

Schafersman (1991) points out the typical trends for educational system today. The process of learning can be viewed as transferring information from the teacher to the student like from the full container to the empty one. The teacher gives the well known facts and the students are not accustomed to questioning them. Teachers are viewed as 'the source of knowledge', preferring to transfer it in a passive way. They are not interested in actively trying to equip the students with discovering and exploring techniques. Paul (1990) concludes that the old view of learning does not correspond to the requirements of today's society which demands management, leadership and decision taking skills so that new generation could understand the process in a progressive way, both in a study or career field.

The issue of developing critical thinking skills deserves greater attention in the context of professional training of future aviation specialists. Federal Aviation Administration (2016) states that human error has accounted for nearly 85% of all aviation accidents over the past 20 years. The FAA also highlights their belief that one reason for pilot error is that pilot training focuses mainly on the skills needed to pass written or practical tests and not enough on critical thinking skills. Wiener (2014) believes that it

is crucial to also focus on the causes of pilot error and ways to prevent these errors in judgement from being repeated. The air crashes where pilots didn't make the only right decision and couldn't assess the situation correctly are numerous. For example, in 2014 TransAsia flight 222 crashed near Magong Airport during landing phase after the request for go-around. The ASC report concluded that the captain's overconfidence in his flying skills resulted in the safety violation (Aviation Safety Council Taipei, 2016, p.5). Adverse weather conditions and human factor are the two key reasons why the aircraft Tu-134 crashed in Karelia in 2011. As the final report states, the reason for the captain's inadequate behavior was the discordance of the expected situation with the real one. In the conditions of rapidly deteriorating weather the captain of the aircraft could have a subjective assessment of the flight situation (Interstate Aviation Committee, 2011).

Critical thinking skills and different aspects of their formation have been an object of much research (Moore & Parker (1995); Steel, Meredith, Temple (1998); Bloom et al., (1956); Ennis (1991); Alvino (1990); etc.). Robertson (2004) in his research focused on teaching pilots judgment, decision-making and critical thinking. But there is still a lack of research regarding the techniques of development of future pilots' critical skills.

2. Literature review

Over the last few decades, critical thinking skills have moved to the centre of research of many scholars who agree that developing critical thinking skills should become a part of the undergraduate curriculum. The notion "critical thinking" has been defined in many different ways.

Alvino's definition of thinking skills focuses on the set of skills that control mental processes (Alvino, 1990, p. 50). Moore and Parker (1995) specify that critical thinking is careful reasoning in order to determine verity of the claim (p.3). Wright (2002, p.43) presents the characteristics of thinking skills. First, it is associated with problem-solving. Secondly, this skill comprises asking questions and helps students to judge arguments and conclusions. Thirdly, it is only possible to use critical thinking on facts, not values. Finally, the terms creative thinking and critical thinking are not interchangeable.

Fisher (1990) states that it is important to both learn how to ask question and, on the other hand, how to give reasons. Wade (1995) defines eight typical features of critical thinkers: they ask questions actively, identify a problem, study evidence, analyze hypothesis and foundations, avoid oversimplification, and take into account other alternatives and allow

ambiguity. Unrau (1997) states that to think critically, a person must learn how to examine claims and develop arguments.

Strohman and Baukus (1995) consider ambiguity to be a key tool in critical thinking. Besides ambiguity, questioning is a crucial part of the critical thinking process. Questioning helps the learner to search for information, encourages replies, gives opportunity to negotiate, promotes understanding, fosters self-regulation, and invites conversation (Rosenshine, et al., 1996).

Peak (1997) and Facione (2007) point out that the qualities that critical thinkers possess differ from the qualities evidenced by non-critical thinkers. Some of the characteristics of a critical thinker are given below: asking questions, assessing arguments, admitting a lack of understanding, having curiosity, analyzing problems, finding new solutions, analyzing interpretations and claims, listening carefully and giving appropriate feedback, looking for evidence, rejecting incorrect information, comparing beliefs, formulating central ideas, etc.

3. Statement of the problem and research questions

Fisher and Scriven (1997) point out that students must be taught critical thinking skills because solving problems is an essential skill in everyday life. Thus, teachers need to focus on teaching critical thinking instead of just making students learn the material given by them.

Teaching critical thinking can be effective within the scope of certain subjects. English is an ideal option because it gives a teacher a possibility to use interactive methods, creativity and gives ground for developing students' critical thinking skills. Freely and Steinberg (2000) emphasize the significance of interactive methods to foster critical thinking skills.

Sharma (1995) states that language is "the vehicle of all thinking" (p. 35). He adds that critical thinking is governed by the level of lexical proficiency and the topic which the participants choose for debate.

Kabilan (2000) emphasizes that learning a language means not only knowing the meaning and using it, but demonstrating critical thinking skills through the studied language, such as generating ideas, supporting arguments, reasoning, and giving examples. Then the scholar concludes that the majority of the teachers ignore learners' abilities and do not take into account their ideas and points of view. As the result, the learners are unable to apply critical thinking skills.

The work of Klimovienė, Urbonienė, & Barzdžiukienė (2006) analyzes the most effective cooperative learning activities for the

development of critical thinking skills and incorporates them in the core of their Business English course. The researchers highlight the connection between critical thinking skills and language proficiency. They admit that activities aimed at developing critical thinking facilitate improving language skills.

Successful training in Aviation English is key to ensuring flight safety. Document 9835 (ICAO, 2010) defines the following communicative functions as essential to aviation safety: giving advice, suggesting solutions of a problem, suggesting alternative courses of action, giving reasons, stating possible consequences of an action/event, predicting a future action/event, indicating deductive reasoning, etc. To ensure aviation safety, pilots and air traffic controllers must demonstrate their ability to analyze problems, make decisions, find possible solutions to a given problem, etc.

The analysis of the literature in the sphere of Aviation English training shows that mostly the emphasis was made on developing language proficiency skills, and critical thinking skills were taught incidentally. However, the researchers (Bystrova, et al., 2019) state that analytical thinking, problem-solving, decision-making are important skills necessary for competitive aviation specialists. They evaluated the efficiency of using problem-based learning methods for teaching Aviation English and emphasized that such activities enhance developing not only communication skills, but also problem solving skills as they model professional situations. Moskalenko and Didenko (2018) studied the development of critical thinking skills, such as analyzing information and distinguishing the main and additional information, in the process of listening skills training. Despite the significance of teaching critical thinking skills in Aviation English, there seems to be a paucity of research in this area.

In the light of the unquestionable importance of the development of critical thinking skills for future pilots, the present study focuses on critical thinking techniques as a tool for enhancing them. Considering the significant role of problem-solving skills for aviation specialists we suggest improving the level of their critical thinking skills within the framework of Aviation English. This study aims at answering the following questions:

Do critical thinking techniques within the framework of Aviation English foster the development of critical thinking skills and to what extent?

3. Method

3.1. Participants

42 first year student pilots from the Flight Academy of the National Aviation University (Kropyvnytskyi, Ukraine) were selected to participate in this study. They entered the Flight Academy having a different level of language proficiency. However, all of them had taken the External Independent Testing in English. This exam is obligatory for Ukrainian school leavers who have an intention to continue their studying in higher educational establishments.

However, the total number of student pilots of the Flight Academy of the National Aviation University is 314 (academic year 2018-2019). We chose 42 student pilots out of the 84 student pilots studying in the first year. They were all between 17 and 22 years of age. They were chosen based on their level of English language proficiency and their critical thinking skills. Participants were only chosen from the first year pilot's class because this is the only year when General Aviation English is taught and when critical thinking skills can be most easily be fit into the curriculum.

A control group and an experimental group were formed with participants in each group being equal in English proficiency and critical thinking skills. Each group consisted of 19 male students and 2 female students.

3.2. Instrumentation and Data collection

P. Honey's questionnaire (Honey, 2004, as cited in Naeini, 2005) was given to all the participants in the study to determine their critical thinking skills level. It evaluates the students' critical thinking skills: inference, analysis, inductive reasoning, evaluation, and deductive reasoning. Honey's critical thinking questionnaire was improved and adapted for Ukrainian students. The reliability of the scale indicated a high internal consistency ($\alpha = .86$) (Naeini, 2005). The questionnaire consisted of 30 statements; students used a 5-point Likert scale to respond. (1 = never – 5 = always) Thus, each testee's score could range from 30 to 150. We distributed the results into 3 levels: low (30-90), middle (91-120), high (121-150). The test was given at the beginning of the course and at the end, and results of the test were used to determine whether or not the teaching of critical thinking skills had a significant effect on student performance.

3.3. Procedure

Forty-two first year student pilots were chosen and divided into two groups: the control group and the experimental one in such a way that these two groups were equal at the level of critical thinking skills. The elements of critical thinking skills were taught within the framework of the General Aviation English course, because this subject allows the integration of professional knowledge, critical thinking, speaking skills and also creativity.

The program of General Aviation English comprised 48 classes, each lasting one hour and twenty minutes. In both groups the same content, which fully corresponded to the syllabus, was taught. In the experimental class, in addition to the course of Aviation English, the teacher applied specially designed tasks aimed at the development of critical thinking skills. During the first class in the experimental group, the students defined critical thinking and its role for the profession of a pilot. The teacher showed some examples of air crashes which took place due to a pilot's inability to make a quick and right decision in a given situation. After that, the teacher presented critical thinking techniques and practiced these skills with the students. The specially designed speaking tasks were based on the content of Aviation English. The students had to identify the problem, analyze it and come up with all possible solutions. After that, they had to evaluate the solutions and choose the most appropriate option justifying their choice. All these tasks were done through speaking activities. The students worked individually, in pairs and in groups. Some examples of these techniques are given below.

The critical thinking technique 'Making a Justified Choice' was aimed to teach students to make a justified choice based on their experience, analyzing and evaluating abilities. Students had to imagine that they were in a miracle shop. They had a list of things which they could buy. They were to choose 4 things from the list. After discussion in pairs, they explained their choices and presented their arguments. Future pilots were offered the following choice: good weather conditions while flying; flying the latest Boeing models; excellent English listening and speaking skills; good visibility when landing; working as a pilot for Pacific International Airlines; no thunderstorm activity during the flight; no danger from birds; good communication in the cockpit; no technical problems during the flight. At the end of the activity students summarized what they had heard from their groupmates. Students then asked wh-questions to ensure comprehension.

The critical thinking technique 'Developing a Critical Mindset' introduced basic awareness of critical thinking. The teacher gave the

students a thought provoking statement such as, “*In a hundred years pilots will have become obsolete because planes will have become fully automated*”. The students were then asked to work individually and chose the response they most agreed with from the choices provided, i.e. I agree, I disagree, etc. Students then worked in pairs and discussed their answers. Students finally presented their opinions to the whole class.

In another critical thinking technique called “Solving a Problem”, students were given a scenario adapted from the book ‘Risk Management Handbook’ (Federal Aviation Administration, 2016, p. 92) and asked to use the PAVE approach (pilot, aircraft, environment, and external pressures) to respond to the situation by deciding whether they would land or continue on to their destination. Students then worked in small groups to discuss their answers and attempted to agree on one response. Finally, each group presented their solution to the whole class.

The key critical thinking skills that were taught are the following: making a justified choice based on students’ experience; analyzing and evaluating ideas; finding possible solutions to a given problem, formulating persuasive proposals, organizing students’ thoughts quickly and coherently; using various analytical tools and practicing solving problems, etc.

At the end of the course Honey’s critical thinking questionnaire was administered again in both the experimental (EG) and control group (CG) to see whether teaching critical thinking techniques had any impact on developing learners’ critical thinking skills.

4. Results and Discussion

The results obtained in critical thinking skills (CTS) pre-tests were distributed into three levels; low, middle, and high (Table 1).

Table 1. Distribution of levels of critical thinking skills (CTS) in control and experimental groups

Study groups			N	Students (Percentage,%)		
				Low	Middle	High
Pre-test Scores in CTS	CG	21	1 (4.8%)	17 (80.9%)	3 (14.3%)	
	EG	21	1 (4.8%)	18 (85.7%)	2 (9.5%)	

To determine if the initial level of critical thinking skills (CTS) was the same in both groups we used an independent samples t-test. As shown

in Table 2, the pre-test mean scores of both groups are not significantly different (M_{CG} : 4.0952, SD_{CG} : .4364, M_{EG} : 4.0476, SD_{EG} : .3842).

Table 2. Results of experimental and control groups in critical thinking skills (CTS) pretest

Study groups			N	Mean	St. Deviation	STD. Error Mean
Pre-test in CTS	Scores	CG	21	4.0952	.4364	.0952
		EG	21	4.0476	.3842	.0838

To test whether the means are significantly different, we used a paired t-test for independent means for the level of critical thinking skills (CTS) pre-tests. The following results were obtained: the t-value– .37529, the p-value– .709425. Therefore, we can conclude that the results of the test proved that the difference was not significant at $p < .05$ at this stage of the experiment.

Based on the pre-test results (Table 3) we can assume that both groups were homogeneous in terms of critical thinking skills at the beginning of the study. The post-test results demonstrated that the performance of the experimental group (M_{EG} : 4.5238) in critical thinking skills was higher than the performance of the control group (M_{CG} : 4.15).

To understand the extent of the development of critical thinking skills, we performed a paired t-test for dependent means. Since in the experimental group the t-value of critical thinking skills is 4.264014, and the value of p is .00038, we can conclude that the results of the groups' performance post-test were a significantly different (at $p < .05$). In the control group the t-value is 1. The p-value is 0.32926, the result is not significant at $p < 0.05$.

Table 3. Paired-samples t-test results in critical thinking skills (CTS) before and after the experiment

Study groups			N	Mean	St. Deviation	STD. Error or Mean
Pre-test CTS	Scores in	CG	21	4.0952	.4364	.0952
		EG	21	4.0476	.3842	.0838
Post-test CTS	Scores in	CG	21	4.15	.4893	.1094
		EG	21	4.5238	.5117	.1116

As we can see from Table 4 the students' performance in the control group has not changed significantly, the growth of a high level in the post-test is only 4.7%. However, after the experiment the level of critical thinking skills in the experimental group has significantly improved, the growth of a high level is 42.9%, low-level students transfer into middle-level group. It can be concluded that the implementation of critical thinking techniques has affected learners' critical thinking skills to a great extent.

Table 4. Distribution of levels of critical thinking skills (CTS) in control and experimental groups before and after the experiment

Study groups		N	Students (Percentage,%)		
			Low	Middle	High
Post-test	CG	21	1 (4.8%)	16 (76.2%)	4 (19%)
Scores in CTS	EG	21	0 (0%)	10 (47.6%)	11 (52.4%)

The results received in this part prove the discoveries in other research papers (Freely & Steinberg, 2000; Sharma, 1995; Klimovienė, Urbonienė, & Barzdžiukienė, 2006) which have shown that English creates favourable advantageous environment for students to become critical thinkers. In addition, the finding that speaking activities facilitate the development of critical thinking skills is similar to the finding of Slavin (1985) and Cooper (1995). Slavin (1985) suggests applying cooperative learning for developing high-order thinking skills. Critical thinking is fostered and students generate ideas through interactive methods. Cooper (1995) states that under favorable conditions students demonstrate a higher level of critical thinking skills when they get support and feedback from a teacher and other students.

Even though the education system in flying institutions did not seem to focus on Aviation English as a tool for developing critical thinking skills, air crashes statistics data on this issue have revealed that there were accidents due to the failures in problem-solving, making the correct judgments, and assessing the situation. The implementation of critical thinking tasks into the core of the Aviation English course can contribute to its development, and in such a way to enhance aviation safety. That is to say, teaching critical thinking develops the abilities to raise questions, solve problems, reason logically, and evaluate other people's arguments.

With critical thinking tools the students had a chance to look deeply into a problem and feel that they were real experts in the sphere of aviation. Sometimes they lacked knowledge in professional areas and this became a

stimulus for their further hard work and improvement. In some activities the students had a difficulty in expressing their point of view. In such situations their groupmates gave them necessary assistance and it helped to develop team spirit. This is also very important as a pilot works with other members of a crew and ground staff, so the issue of cooperation is to be considered as well.

Thus, the superior performance of the experimental group of participants on the post-test on critical thinking can be explained by the important role of critical thinking instruction. It helped to develop students' critical thinking skills and motivated them to think, speak and learn more during the class.

5. Conclusion

The results of the conducted research showed that the experimental group did better in comparison with the control group in critical thinking skills. That is to say, the students who received instruction in critical thinking strategies demonstrated a higher level of critical thinking post-test. There is no doubt that two groups demonstrated progress in critical thinking skills compared to the level at the start of the course of Aviation English, but in the experimental group, the progress was much more noticeable. As a result, we conclude that integrating critical thinking strategies into the course of Aviation English has a tremendous effect on developing critical thinking skills which are the foundation of a pilot's expertise and his passengers' safety.

Our research revealed that critical thinking techniques helped the learners to organize their thoughts logically. They had the possibility to express and prove their points of view presenting arguments. The learners interacted with their groupmates, asked questions, and agreed or disagreed with other points of view. They felt that they were important participants of educational process and their point of view was important.

Specially-designed tasks were a strong motivator for students to think and speak. The assignments were based on factual information and this fact helped to create "real-life" situations in the classroom. The students got even more interested in their future job and this encouraged them to learn professionally oriented subjects more thoroughly.

Critical thinking strategies taught the learners that other people could have a different view on a problem. They started to accept this fact and respect their groupmates although they had different opinions.

All this suggests that critical thinking strategies should be integrated into the Aviation English courses in other educational establishments that train future pilots. This study can serve as a guideline for flight school English instructors writing syllabus, working out the guidelines and preparing lesson plans. Moreover, when educating student pilots, critical thinking strategies can be applied to the language classroom in order to make some contribution into the process of building up their future job awareness. In such a way, the future pilots know the procedure for taking decisions in standard and non-standard situations. Therefore, by providing student pilots with decision-taking techniques, we will make our contribution into increasing the level of safety in the world of aviation.

Critical thinking assists in mastering all language skills: speaking, reading, listening and writing. These aspects can become an object of further research.

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