An Impact Study on Large-Scale Aviation English Tests Based on Data Mining

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Abstract

According to the results of the study of aviation incidents and accidents that have occurred over the years, the poor use of English in aviation, i.e., the poor listening and speaking skills of pilots and air traffic controllers is one of the main causes of aviation accidents. Therefore, the International Civil Aviation Organization (ICAO) has adopted strengthened language proficiency requirements for flight crew and air traffic controllers operating along international air routes. In order to evaluate the language proficiency of civil aviation pilots in a more effective and professional manner, Pilots' English Proficiency Examination of CAAC (PEPEC) was developed by CAAC in accordance with the international standards set by ICAO. As high-stakes tests, PEPEC affects not only pilots and ATC, but also the civil aviation industry, and even the society as a whole. The current study aims to investigate the impact of PEPEC on the English learning and working of pilots. In reference to the aviation tests impact model, a muti-phase and multi-method research design based on data mining has been developed to investigate the impacts of PEPEC on pilots to explore their perception and evaluation of these tests, as well as the impact of the test on their learning, working or designing practice. Various research methods have been employed, such as questionnaire surveys, interviews and document analysis. The results reveal that PEPEC has exerted a strong promoting impact on English learning and on the test takers' English proficiency in working and their working competence. The findings of this research provides implications for the further improvement of the candidates' English proficiency in that even if they have achieved Level 4 in the tests and their English proficiency in working is improved, many pilots still have inadequate ability in communication in international operations and the new testing system based on artificial intelligence and machine learning should be developed.

Keywords: Pilots' English proficiency examination of CAAC (PEPEC), ICAO language proficiency requirements (ILPR), test impact (TI), aviation English (AE), data mining (DM).

1. Introduction

Research on aviation incidents and accidents over the years indicates that inadequate English proficiency, specifically in listening and speaking among pilots and air traffic controllers, is a primary factor contributing to aviation accidents[1,2]. Therefore, the International Civil Aviation Organization (ICAO) has implemented enhanced language proficiency standards for flight crew and air traffic controllers who operate on international air routes[3]. As a result of the new Standards and Recommended Practices (SARPS), more stringent language testing requirements must be implemented by 2008, pilots and air traffic controllers must demonstrate proficiency at the ICAO Operational Level 4 in order to maintain their license to operate internationally. In order to meet the new language skill requirements set by ICAO, to improve the English proficiency of the majority of Chinese civil aviation pilots to meet the requirements of aviation operations, and to evaluate the language proficiency of civil aviation pilots in a more effective and professional manner, the Flight Standards Department of CAAC developed

the web-based Pilots' English Proficiency Examination of CAAC (PEPEC) in accordance with the international standards set by ICAO.

As a high-stakes test, PEPEC will affect not only pilots, but also the civil aviation industry, and even the society as a whole. The current study focus on the impact of the aviation tests on the learning and working of pilots. In reference to the aviation tests impact model, a muti-phase and multi-method research design has been developed based on data mining to investigate the impacts of PEPEC on pilots, to explore their perception and evaluation of these tests, as well as the impact of the test on their English learning and working.

2. Literature Review

As an important form of assessment, tests not only test test takers' knowledge and abilities, but also have intended or unintended effects on test stakeholders. The terms washback and impact both mean effects, with the former usually referring to the effects of the test on teachers and students and their teaching and learning, i.e., the backwash effects[4,5], and the latter mainly referring to the effects of the test on individuals, the educational system, and society, i.e., the test effect. The washback effect is part of the test effect[6,7]. Since the 1990s, the washback effect has received a lot of attention in the language testing field.

A number of insightful washback models have been proposed by scholars over the past 20 years, such as Alderson, Hughes, Green, Shih, and Huang. Alderson et Wall's 15 washback effects hypothesis explores the effects of testing on the content, methods, rate and sequence, degree and depth, and attitudes of teaching and learning[8,9]. Hughes' basic washback model of participants, processes, and outcomes outlines the mechanism of the test backwash effect and is the most widely used theoretical model in empirical studies of the washback effect[10]. Green's model expands on earlier theories of washback effects by incorporating the nature, variability, and strength of washback effects and defining the factors that influence the strength of washback effects[11]. Shih's new washback effect model focuses on the factors contributing to the washback effect and the relationship between the components of the model, reflecting the complexity of the washback effect[12]. Huang Dayong proposed a model of the language test effect based on a review of theories of the test effects[13]. Huang's model applies Bourdieu's social practice theory to examine and interpret the test effect phenomenon, which not only enriches our understanding of the washback effects, but also broadens the perspective of washback research.

In recent years, researchers have shifted their attention to the educational, social, cultural, and political contexts in which the tests are administered. In 2014, Huang explores the social and educational effects of College English Tests (CET) Band 4 and 6[14]. This empirical study is not limited to the analysis of the washback effect, but more importantly, it provides a comprehensive study of social and educational effects beyond the classroom, not only providing an empirical basis for the study of test effects, but also proposing a theoretical framework for test effects.

Huang proposed a theoretical framework for testing effects, i.e., Test Impact Model (Figure 1)[10]. In this model, there are 4 factors involved:

- the impact introducers – test users;
- the impact medium – the test;
- the impact receiver – e.g. students, teachers;
- the impact context – e.g. economic, educational, political, social,
- and cultural contexts.

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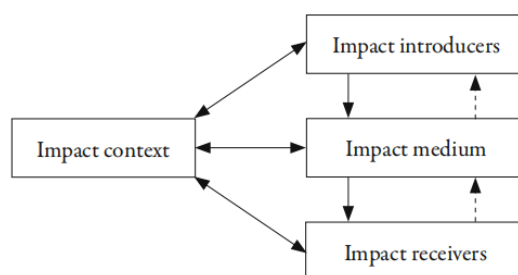
Figure 1 Test impact model

Based on the previous theoretical models and empirical studies, a Aviation English Tests Impact model (Figure 2) is drafted, to illustrate the working mechanisms of Aviation English Tests Impact.
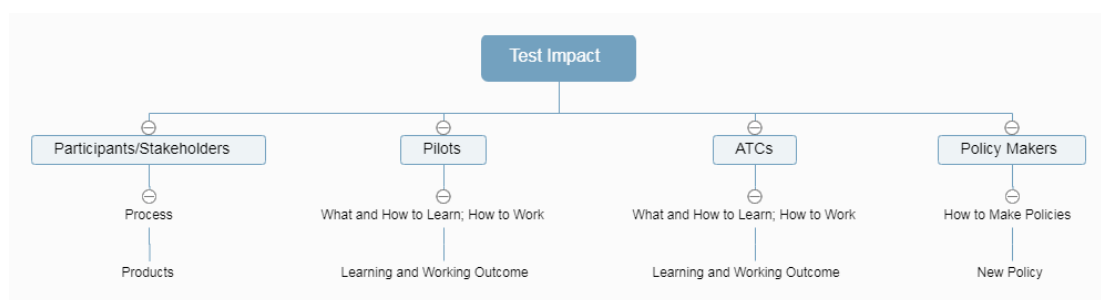

Figure 2 Aviation English tests impact model

This model, as shown in Figure 2, incorporates Green, Huang and Messick's theory of consequential validity, which demonstrates the stakeholders who are been impacted by the aviation tests, as well as the working mechanism of the aviation tests' impact[16,17]. This model illustrates both the content and the mechanism of aviation tests' impact. Aviation tests will influence its stakeholders, whose actions will change accordingly[18]. The stakeholders include pilots, ATCs, and policy makers and so on. Of course, the stakeholders can be more than those listed in the model. Under the impact of the aviation tests, the stakeholders' learning and working processes will change, yielding different products. Moreover, every category of participants, processes and products may influence each other. For instance, learning can be affected by the change of the tests, and the test reform may be induced by English learning of the participants.

In summary, in language testing, the research on test effects has made great progress, moving from the initial study on the washback effects to the exploration of educational, social, cultural, and political factors and operational mechanisms that contribute to test impacts[19,20].

3. Introduction To PEPEC

The structure of the PEPEC is outlined in Table 1. There are 5 parts in PEPEC, including listening comprehension, phrase repetition, simulated RTF communication, story retelling, and oral proficiency interview(OPI).

Table 1 PEPEC structure

Testing Parts	Testing Content	Number of Testing Items
Part 1 Listening Comprehension	Routine and non-routine RTF short exchanges, and aviation related statements	20 items
Part 2 Phrase Repetition	Routine and non-routine RTF communication	20 sentences
Part 3 Simulated RTF Communication	Situational RTF communication	20 exchanges
Part 4 Story Retelling	Aviation related stories	1 story
Part 5 Oral Proficiency Interview	Aviation related topics	15 questions

The listening comprehension section tests the test taker's ability to obtain verbal information. The recorded material is spoken at a rate of 100-120 words per minute. The test is in the form of multiple-choice questions. The test taker selects one correct answer from four choices directly on the computer. The listening portion of the test is scored by the computer system and takes approximately 15 minutes.

The phrase repetition section tests the test taker's ability to correctly hear and repeat the phraseology of radio-telephony communication under normal and abnormal conditions. This part of the test requires the test taker to repeat what he or she has heard. The recorded material is spoken at a rate of approximately 100-120 words per minute. The test taker's score is assigned based on the recording of what the test taker has heard by the scorer. This part of the test takes approximately 15 minutes.

The simulated RTF communication test the test taker's ability to use standard ICAO phraseology and procedures in normal and abnormal conditions, and test the test taker's overall ability to use language in a simulated work environment. This section consists of 15 to 20 conversations. The simulated scenarios are set according to the CAAC published charts and airline call signs. Before the test begins, the background information related to the test scenario is displayed on the test taker's computer screen, the controller's instructions and prompts are played on the computer, and the test taker is given 30 seconds to respond in the role of a pilot with reference to the computer screen. After the test taker finishes answering, he/she can click the end button to go to the next dialogue. The test taker's verbal responses are automatically recorded by the computer, and their scores are evaluated by the scorer based on the reference answers and the five rating scales in the aspects of pronunciation, structure, vocabulary, fluency and comprehension of the language, from the highest level 6 to the lowest level 1 of English proficiency. This part of the test takes about 15 minutes.

The story retelling test the test taker's listening comprehension and oral expression skills in aviation English. The audio recording is a short story related to aviation, with a length of about 60-100 seconds and a speech rate of about 100-120 words per minute. The audio recording was played twice, with a 10-second interval between the two times. After listening to the recording, the test taker had 300 seconds to think and verbally retell the content of the short story. The scorer assesses the test taker's listening and speaking ability from the highest level 6 to the lowest level 1 according to the ICAO's five rating scales in the aspects of pronunciation, structure, vocabulary, fluency and comprehension. This part of the test takes approximately 10 minutes.

The PEPEC Oral Proficiency Interview (hereinafter referred to as OPI) is a semi-direct computer-based video interview between the interviewer and the test taker (i.e., the interviewer and test taker conduct a computer-mediated video interview). The OPI is a computer-based, semi-direct test that tests the test taker's listening comprehension and oral expression skills of English. The OPI assesses the test taker's English language ability from the highest level 6 to the lowest level 1 in terms of pronunciation, structure, vocabulary, fluency, comprehension, and interaction.

The OPI is divided into four phases: warming-up, level-check, probe, and wind-down. The OPI interviewer asks questions according to the requirements of the 4 phases. The requirements for each phase of the OPI are as follows.

- Warming-up: Approximately 1 to 2 minutes. The test takers have to answer some simple, everyday English questions asked by the interviewers.

- Level-check: Approximately 5 to 6 minutes. The test takers answer questions related to the aviation and the basic language level of the test takers are accessed.

- Probe: Approximately 6 to 7 minutes. The OPI interviewer asks in-depth aviation related questions displayed on the screen to facilitate further assessment of the test taker's professional English proficiency.

- Wind-down: Approximately 1 to 2 minutes in length, the OPI interviewer ends the oral proficiency interview by asking simple questions to make the test taker relax himself.

4. Research Design

Before As outlined in the Aviation English Tests Impact model washback model (Figure 2), the participants involved are pilots, ATCs, and policy makers. In reference to the aviation tests impact model, a muti-phase and

multi-method research design based on data mining has been developed to investigate the impacts of PEPEC on pilots, to explore their perception and evaluation of the test, as well as the impact of the test on their learning, working or designing practice[21]. Moreover, various research methods have been employed, such as questionnaire surveys, interviews and document analysis.

The current research can be conducted in the following stages. Firstly, large-scale questionnaire surveys are conducted among pilots to collect their basic information and to investigate their perception and evaluation of the aviation English tests' impact on them. Next, in the second stage, supplementary interviews are conducted among selected participants, to seek answers to problems emerged in the questionnaire surveys. Finally, such documents as the tests' documents of ICAO and CAAC, PEPEC testing syllabuses, and some other related documents are analyzed.

4.1 Participants

Major participants of the current study are airline pilots who have already taken the PEPEC. An investigation among them will help us understand the impact of the aviation English test on their learning and working, which is of utmost importance in this research, since the fundamental aim of the test is to enhance the English proficiency of pilots to help them perform better in their work.

4.2 Instruments

Major research instruments used in the current study are questionnaires and interviews, which will be introduced in detail in the following part.

4.2.1 Design for the questionnaire survey

In the current research, questionnaire surveys are conducted first to collect information from pilots nationwide to find out the general situation of the aviation English test impact.

The content of the questionnaire surveys mainly covers five aspects. First, the participants' personal information is collected, because different participants' characteristics may contribute to their perception of PEPEC and the impact of the tests. Second, stakeholders' evaluation of the test' impact intensity on English learning is surveyed. Third, stakeholders' perception of the test' impact learning is investigated, to find out on which aspects the tests exerted impact, such as learning content, methods, etc. Fourth, attempts have been made to explore stakeholders' perception of the test' impact on English proficiency in working. Last, stakeholders' opinions are sought as to the test's impact on their working competence.

When designing and revising the questionnaires, the researcher has frequently consulted the testing experts, discussed with PEPEC candidates, and communicated with colleagues teaching related courses.

The questionnaires for pilots were distributed in March, 2018 to 500 pilots selected according to their professional titles and working regions, to ensure that pilots in all the major airlines of CAAC are covered.

The valid questionnaires were put into computer and the five-point Likert-scale questions was processed by SPSS 17.0, while answers to short-answer questions were collected, sorted, coded, analyzed, and saved.

Both descriptive and inferential analyses were performed. A reliability test was run on item 32, 34 and 35 of the pilots' questionnaire data, all of these are five-point Likert scale items. The results are listed in the following table (Table 2). From Table 2, it can be seen that Cronbach's Alpha is above 0.8, which attests to the satisfactory internal consistency of the questionnaire.

Table 2 Reliability test for pilots' questionnaire

N of items	Returned N	Cronbach's Alpha
3	439	0.929

4.2.2 Design for the interviews

Interviews were a supplementary instrument used in this research. They were conducted to identify possible causes of conflicting research findings, and to verify statistical results in questionnaire surveys. The main participants are

pilots who have answered the questionnaires. Pilots at three levels of English were selected for the semi-structured interviews: ICAO level 5, level 4 and below level 4. The interviews were either conducted individually or in groups. The interviews were recorded using a digital voice recorder for further analysis.

Altogether 6 airline pilots were interviewed. 4 of the pilots surveyed are airline pilots who had flown international flights for more than 5 years and another 2 are student pilots in airlines. 2 of them are from China Southern Airline, 2 from China Eastern Airline and anther 2 come from Air China. Among the 6 pilots, 2 of them have achieved ICAO Level 5, 2 have achieved Level 4 and another 2 achieved Level 3.

5. The Consequences

5.1 The impact of PEPEC on English learning

5.1.1 Perception of PEPEC impact intensity on English learning

Item 32 from the pilots' questionnaire is designed to investigate the pilots' perception of PEPEC impact intensity on English learning. Table 3 shows that 5.24% of all respondents indicated that PEPEC didn't promote their English learning, while 10.71% of the respondents reported that PEPEC promoted their English learning only by 25%; In this question, more respondents agreed on the promoting role of PEPEC on English learning with 84.05% of them responding that this test promoted their learning of English by more than 50%. As indicated in Table 3, PEPEC has exerted a promoting impact on pilots' English learning and the intensity of this effect is great for most of them.

<p align="center">Table 3 Reliability test for pilots' questionnaire</p>

Intensity	Number	Percentage	
0%	23		5.24%
25%	47		10.71%
50%	112		25.51%
75%	173		39.41%
100%	84		19.13%
Total Number	439		

5.1.2 Perception of PEEPC impact on English learning

Item 33 from pilots' questionnaire was an open-ended question to investigate the areas of English learning impacted by PEPEC. 355 respondents from pilots' questionnaire responded that PEPEC had impacted their learning of English. According to Alderson and Wall (1993), a test will affect what learners learn and how learners learn, such as the learning content, method, rate and sequence, and degree and depth. From their responses, the candidates' perception about the PEPEC impact on English learning can be classified into 4 categories: learning motivation, learning interests, learning methods, and learning content.

a) PEPEC Impact on Learning Motivation

Results from pilots' questionnaire:

95 valid responses for item 33 from the pilots' questionnaire are related to PEEPC impact on English learning motivation, which can be further subdivided into two categories, positive impact on learning motivation(A1) and negative impact on learning motivation(B1), as indicated in Figure 3. Based on the figures listed in Figure 3, the following findings can be summarized.

First, only 26.77% of respondents expressed their English learning motivation were impacted by PEPEC is small, which indicated that PEPEC played an insignificant role in influencing pilots' English learning motivation.

Second, the number of respondents who expressed that their English learning motivation was promoted by PEPEC far surpasses that of respondents who expressed PEPEC has dampened their English learning motivation, which indicated that PEPEC exerted more positive influence on pilots' English learning motivation than negative influence.

Last, it can be inferred from those responses, most of the motivation comes from learning to pass the test for graduation and transition training, and PEPEC serves as a compulsive means as well as a stimulus for pilots to learn English.
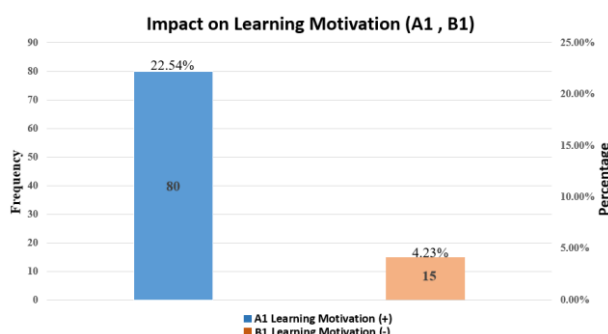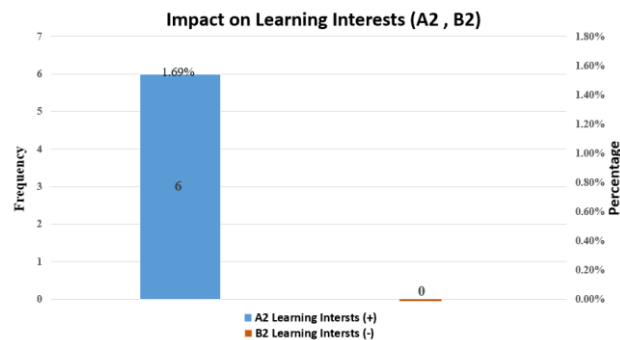

Figure 3 Pilots' perception of PEPEC impact on english learning motivation

Results from pilots' interviews:

The following are some excerpts from the interviews with the six pilots in response to the question probing PEPEC impact on their English learning motivation.

P1(Level 5)

PEPEC enhances our motivation in learning English, and allows us to learn English and expand our professional knowledge at the same time. The test motivates pilots to continuously learn professional related English to meet the requirement of the test.

P2(Level 4)

PEPEC has greatly motivated me to learn more about the flight operation and the radio-telephony communication.

P3(Level 3)

I think PEPEC motivates pilots to learn English, after all, it is closely related to our work.

P4(Level 5)

The pass requirement of PEPEC has made me more initiative in learning English, which is important to pilots. I will pay more attention to some commonly used English radio-telephony communication phraseology. I was motivated to learn English so as to deal with the retests comfortably. For example, the interview session of OPI can better motivated us to frequently go through the English manual and learn to express our understanding of the aircraft system in English. In addition, the high requirement of ICAO rating scale will encourage pilots to improve on their current proficiency of English.

P5(Level 4)

When I studied for PEPEC, it boosted my motivation for learning English, because I found out my deficiency in speaking aviation English, so I had the motivation to improve my English.

P6(Level 3)

PEEPC has motivated me to learn English, because it is a mandatory requirement to pass the test, which is quite challenging for me.

All the pilots being interviewed agreed that PEPEC has exerted positive impact on promoting their English learning motivation. They were more motivated in learning aviation English, especially radiotelehpony communication and OPI related topics. From their responses, it can be inferred that test content and marking criteria provide a strong impact on learning motivation.

b)   PEPEC Impact on Learning Interests

Results from pilots' questionnaire:

Another very important aspect of PEPEC impact is about its impact on English learning interests. As is shown in Figure 4, altogether only 6 responses to item 33 in the pilots' questionnaire are related to the PEPEC impact on English learning interests, and all the 6 responses are about positive impact on learning interests(A2) and none of those is about negative impact on learning interests(B2).

It can be concluded from all the data in Figure 4 rests of pilots and the test influence on English learning interests should be further analyzed from the interview data.

Figure 4 Pilots' perception of PEPEC impact on English learning interests

Results from pilots' interviews:

The following are some excerpts from the six pilots' interview responses to the question of PEPEC impact on their English learning interests.

P1(Level 5)

PEPEC enhances our interests in learning English and we are learning English on a long term basis.

P2(Level 4)

It has greatly enhanced my interest in learning English and the knowledge of the radio-telephony communication.

P3(Level 3)

I don't think PEPEC promotes pilots' interests in learning English, and we just compelled to learning English to pass the test.

P4(Level 5)

The PEPEC made us get familiar with the words and phrases related to aircraft systems and the various non-normal procedures, which which improves our interest in learning English.

P5(Level 4)

I don't have any interest in learning English, and I just learn English for my flight career.

P6(Level 3)

PEPEC improves my English learning interests to some extent.

The data indicate that the PEPEC stimulates the interest of learning English just for some pilots. It is obvious that the pilots' interests in learning English were little influenced by the test, which is coherent with the questionnaire data. It can be inferred from the above data that the PEPEC serves as a compulsive means as well as a stimulus for pilots to learn English.

c)   PEPEC Impact on Learning Strategy

Results from pilots' questionnaire:

As indicated in Figure 5, PEPEC has a great effect on pilots' English learning method and there are 197 responses to the item in pilots' questionnaire which are closely related to impact on learning method.
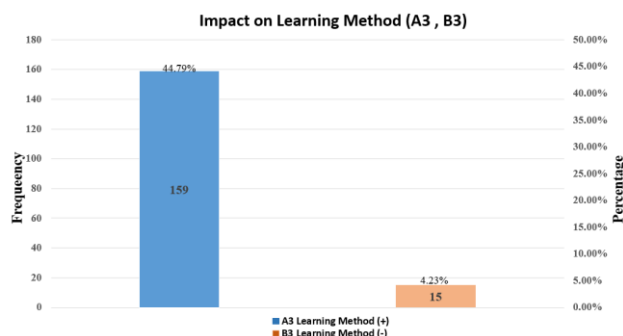

Figure 5 Pilots' Perception of PEPEC impact on English learning method

From Figure 5, it can be noticed that PEPEC exerts more positive influence on English learning methods that negative ones, since 44.79.% of the pilots expressed that PEPEC has beneficial influence on their English learning method, while only 4.23% of the pilots believed in the harmful effects of PEPEC on learning method.

Another conclusion which can be drawn from the questionnaire data is that the most often used learning strategy by pilots is to learning English through listening and speaking. Some respondents indicated that they practice English listening and speaking more often that before and they would try to use as many aviation vocabulary as possible when appropriate; some respondents expressed that they gave more emphasis on enhancing their listening ability; some replied that they tried to speak more fluently in English and some said they tried to improve their English pronunciation. It can be inferred from their responses that the test format and ICAO rating scale in terms of pronunciation, vocabulary, fluency are conducive to the test impact on learning strategy.

Results from pilots' interviews:

A further investigation is made by interviewing pilots about their views on the PEPEC impacts on English learning method and the following are some excerpts of their replies.

P1(Level 5)

PEPEC allows us to learn English with specific strategies mainly in the areas of listening, pronunciation, vocabulary, fluency, comprehension, and responsiveness to horn the pilot's professional English skills. When learning English, we would pay special attention to these aspects, so that we can learn professional English quickly and accurately and efficiently, and build up a solid English foundation for ourselves.

P2(Level 4)

I should listen more and speak more, because I am poor in speaking.

P3(Level 3)

The most important thing in learning English is to be able to understand, express and extract the main points.

P4(Level 5)

When I find myself deficient in speaking and intonation, I take the initiative to imitate the pronunciation of the native English speakers, and I also go to the English corner from time to time to communicate with foreigners or English lovers to improve my speaking ability. In terms of listening, I often listen to the real air-ground communication recordings and try to copy them and repeat them correctly.

P5(Level 4)

I feel that learning a language should be similar, whether it is professional English or every English in life. Learning English for PEPEC made me to pay special attention to listening and speaking.

P6(Level 3)

I think the most effective way to learn English is to listen more and speak more. Anyway, practice makes perfect.

Pilots interview findings coincide with that of questionnaires and most of the influence may comes from the test format and rating criteria.

d)   PEPEC Impact on Learning Content

Results from pilots' questionnaire:

Figure 6 provides information on the PEPEC impact on learning content. As can be seen in the figure, PEPEC seems to affect pilots' English learning content to some extent with 80 of them responding that the test has affected their English learning content.

From Figure 6, it can be noted that PEPEC has much more positive influence on English learning content that negative one with 21.41% of the respondent agreed positive influence and only 1.13% of them expressed negative influence.

From the pilots' questionnaire, some respondents answered they were learning of radiotelephony communication most of time; Some pilots replied that they gave more importance to the learning of standard RTF phraseology; while others replied that they spent more time on the learning expressions used for emergency situations.

A further investigation was made through interviews to reveal pilots attitudes toward the PEPEC impacts on learning content.
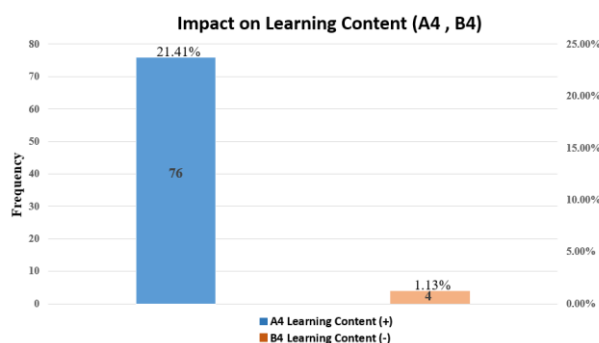

Figure 6 Pilots' perception of PEPEC impact on English learning content

Results from pilots' interviews:

The following are some excerpts from the pilots' interviews about their perception of PEPEC impact on learning content. Generally speaking, their views on the test impact were positive, though their opinions varied on some aspects.

P1(Level 5)

PEPEC also has an impact on the our English learning content, making us to learn more about aviation English, for example, we would pay more attention to the special meaning of the vocabulary which are different when used in civil aviation. What's more, another important aspect in learning English for PEPEC is to enlarge the aviation knowledge.

P2(Level 4)

PEPEC make me aware of my vocabulary deficiencies and I made more effort to enlarge my aviation vocabulary.

P3(Level 3)

PEPEC help me a lot in my future international flights, by letting me learn more aviation English terms and knowledge, which is quite important for communication in international flights.

P4(Level 5)

The impact of PEPEC on the English learning content is shown in many areas. First, PEPEC is particularly demanding on radio-telephony communication, pilots not only have to understand the meaning of the controllers' instructions and clearances, but also be able to read back correctly and accurately. The pilots must also be sensitive to the numbers and letters (such as altitude FL and route B213, etc.), which are critical information in radio-telephony communication. Second, the interview topics of PEPEC made us to learn various aspects of aviation, and we would try to speak in an organized manner. Storytelling and 900 sentences can train pilots to memorize long sentences by extracting the core words in the sentences to remember the meaning of the whole sentence, so that they can repeat the sentences completely and accurately.

P5(Level 4)

Initially, the improvement of English ability was limited to the professional English vocabulary, but later, it was found that the improvement of learning English expressions and sentences is more important.

P6(Level 3)

PEPEC mainly focuses on radio-telephony communication, and I would give more effort to learn RTF phraseology.

The findings from the interviews complies with that from the questionnaire survey. It can be concluded that the test content and marking criteria have a large impact on pilots' English learning content.

5.2 The Impact of PEPEC on Working

5.2.1 Perception of PEPEC Impact on English Proficiency in Working

Results from pilots' questionnaire:

Items 34 from the pilots' questionnaire is designed to investigate the pilots' perception of PEPEC impact intensity on English proficiency. Table 4 shows that 5.47% of all respondents indicated that PEPEC didn't promote their English proficiency in working, while 13.44% of the respondents reported that PEPEC promoted their English proficiency in working only by 25%; In this question, more respondents agreed on the promoting role of PEPEC on English proficiency in working with 61.09% of them responding that this test promoted their English proficiency in working by more than 50%. As indicated in Table 4, PEPEC has exerted a promoting impact on pilots' English proficiency in working and the intensity of this effect is great for most of them.

Table 4 Pilots' perception of PEPEC impact intensity on English proficiency in working

Intensity	Number	Percentage
0%	24	5.47%
25%	59	13.44%
50%	122	27.79%
75%	190	43.28%
100%	44	10.02%
Total Number	439	

Results from pilots' interviews:

Pilots' perception of PEPEC impact on English proficiency in working was further explored through interviews and the following are some of the excerpts of the interviewees' responses to the question whether PEPEC has promoted the improvement of English proficiency in working and how.

P1(Level 5)

PEPEC promotes the improvement of English proficiency in our practical work. Nowadays, all major flight schools and airlines have requirements for pilots to achieve PEPEC level 4 to graduate and to fly international flights. Because of the mandatory test requirements, pilots will take the initiative to use English in their daily life and consciously develop their English skills, which will have a positive impact on their daily work.

P2(Level 4)

By memorizing 900 sentences and practicing radio-telephony communication to pass the test, we have basically mastered English communication skills for international flights.

P3(Level 3)

English proficiency is very important in international flight operations where, after all, language accents differ. To pass PEPEC, we have make more efforts to learn aviation vocabulary and terminology, we spent more time on listening and speaking and we also had a lot of simulated RTF practice, during the process of which the actual our communication skills in English in work are improving.

P4(Level 5)

The testing content of PEPEC covers almost all the knowledge of civil aircraft in English. For example, the main systems of the aircraft, hydraulic system, electronic system, flight control system, etc., and all the words covered are used in daily operation. Learning for PEPEC is very beneficial for the pilot students to transit to a new aircraft type. In addition, all domestic airlines have recruited many foreign captains, and PEPEC learning will lead to a safer and smoother CRM. All pilot students need to achieve the ICAO level 4 before they can enter the company for operations, which actually ensures that overall English proficiency in working are improved.

P5(Level 4)

I believe the English proficiency are promoted. After learning for PEPEC, I was able to understand the relevant English original manuals when working.
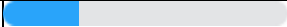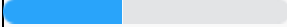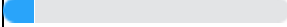
P6(Level 3)

Learning for PEEPC made us try to learn more typical conversations in different situations and it helped us to understand more quickly and accurately the intentions of the controllers when they have accents in real radio-telephony communications.

5.2.2 Perception of PEPEC Impact on working competence

Results from pilots' questionnaire:

Items 35 from the pilots' questionnaire is designed to investigate the pilots' perception of PEPEC impact intensity on working competence. Table 5 shows that 6.38% of all respondents indicated that PEPEC didn't promote their working competence, while 13.67% of the respondents reported that PEPEC promoted their working competence only by 25%; In this question, more respondents agreed on the promoting role of PEPEC on working competence with 79.96% of them responding that this test promoted their working competence by more than 50%. As indicated in Table 5, PEPEC has exerted a promoting impact on pilots' English proficiency in working and the intensity of this effect is great for most of them.

Table 5 Pilots' perception of PEPEC impact intensity on working competence

Intensity	Number	Percentage
0%	28	6.38%
25%	60	13.67%
50%	119	27.11%
75%	185	42.14%
100%	47	10.71%
Total Number	439	

Results from pilots' interviews:

Through the interviews, pilots' perceptions on the PEPEC impact on working competence was further explored. The following are some of the excerpts of pilots' responses to the question whether PEPEC has promoted the improvement of working competence and how.

P1(Level 5)

PEPEC has promoted the improvement of our working ability. By learning professional English and aviation related knowledge, we have effectively expanded our knowledge, and at the same time, by improving our English, we have enhanced the efficiency of our communication with air traffic control, which contributed to ensuring flight safety. Pilots with better professional English proficiency can fly international routes, which are known to have higher salary than domestic routes in general, and have more opportunities to perform flight missions. Thus, pilots made great efforts to improve their English proficiency due to the test.

P2(Level 4)

Yes, the test made us to continue to improve our English and in this way our working competence was enhanced over time.

P3(Level 3)

PEPEC has improved our working ability. We have to refer to the operation manuals to handle some unusual or emergency situations when encountered. However, the manuals are often mistranslated, and we now can read and understand the English version because our aviation English proficiency was improved.

P4(Level 5)

PEPEC also has a great impact on the operational ability of pilots. First of all, international flights require pilots to have strong English communication skills, not only to be able to deal with normal situations, but also to be able to accurately and concisely communicate with ATC in non-normal situations. Now we are able to use some words like blower fan failure, avionics ventilation failure, and other phrases that are not commonly used under some situations. Secondly, PEPEC ensures that pilots master almost all the words they need. When flying with foreign instructors or foreign captains, it is inevitable that they need a large vocabulary to avoid mishearing or missing critical words and phrases, which may have an impact on flight safety, and it is undoubtedly beneficial to CRM if communication is smooth. PEPEC learning makes it easier for pilots to accept new concepts, such as the recently proposed core competencies for pilots by the CAA, which quantifies and evaluates style, i.e. KSA, K-knowledge, S-Skill, A-Attitude, and understanding their meaning makes it easier to remember these competencies. Finally, having a higher PEPEC level will have a better impact on one's career prospects. For example, in various companies there are some requirements that pilots have to achieve PEPEC level 5 to be English instructors whose duties are to train and teach radiotelephony communications for international flights, which will certainly be beneficial to ones' career if PEPEC level 5 was achieved.

P5(Level 4)

There is a promotion in our working competency, because for radiotelephony communication English listening and speaking skills are indispensable. And in terms of reading, due to a large number of manuals translated by machine, sometimes some are mistranslated, so we have to go back to check the original English version of the manual, and PEPEC learning made it easier to read the original manuals, in this way the test helps to improve the professional skills.

P6(Level 3)

PEPEC learning helps us to understand more quickly and accurately the intentions of the controllers when they have accents in real radiotelephony communications by learning some typical conversations in different situations.

6. Conclusions

6.1 Summary

The research findings indicate that PEPEC has a significant positive impact on English learning, particularly in terms of enhancing learning motivation, interests, methods, and content. The test format, content, and rating criteria play a crucial role in influencing pilots' focus on listening and speaking abilities. However, there are shortcomings identified in terms of candidates' understanding of the rating criteria and limited strategies to improve certain language proficiency aspects. The emphasis on radiotelephony communication skills, both standard phraseology

and plain English, is highlighted, but there is a need to include more sections focusing on plain language related to aviation.

Regarding the impact on working proficiency, PEPEC has positively influenced test takers' English proficiency in their work settings, particularly in aviation-related contexts. The inclusion of extensive phraseology and diverse scenarios in the test contributes to enhancing pilots' experience in handling abnormal situations. However, despite improvements in English proficiency, some pilots still exhibit inadequate communication abilities in international operations.

6.2 Implications

According to the research findings, a series of initiatives should be taken to enhance the positive impact of PEPEC. To begin with, accessibility of the rating criteria should be improved to ensure candidates fully understand the assessment standards, supplemented by detailed explanations and training to boost understanding of the test. Additionally, effective strategies should be developed and provided to strengthen language structures, comprehension, and interaction skills of the candidates. Further more, the test content should be expanded to include sections on plain language relevant to aviation and radiotelephony communication, broadening the evaluation of candidates' English proficiency in diverse contexts. Finally, specialized training programs should be designed to improve pilots' communication skills in international operations, focusing on handling various communication scenarios and boosting overall professional competence.

Acknowledgment

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