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# Scenario-Based Learning and Assessment for Second Year Aviation Students*

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The aviation courses, *Navigation and Flight Planning 1* and *Navigation and Flight Planning 2*, offered in the Bachelor of Applied Science (Civil Aviation) at the University of South Australia (UniSA), Adelaide, Australia, provide the aeronautical knowledge requirements of five of the eight Civil Aviation Safety Authority's Air Transport Pilot Licence Examinations. Although scenario-based learning has been used for a number of years in these courses, scenario-based assessment has not been used until recently. In previous years, the final assessment of student learning was mediated by way of examination. This allowed an assessment of critical aspects of aviation education – speed and accuracy. However, there is a question as to whether the examination accurately assessed the level of student learning in all areas of the syllabus, especially given the amount of material to be learned. To this end, this project investigated a compromise assessment, the one-day scenario-based assignment. This was hypothesised to both assess a student's level of learning in a larger proportion of the course and impose some requirements for the assessment of speed and accuracy. The author discusses the results of this project in this article.

## INTRODUCTION

It is vitally important for a pilot to have the ability to accurately flight plan. One of the most important functions of flight planning (if not the most important function) is the calculation of the minimum flight fuel required for the flight. Failure to accurately calculate the flight fuel could very well result in an aircraft running out of fuel with the potential for a large loss of life.

Since 1 January 1983, the National Transportation Safety Board (NTSB) in Australia has maintained a national database of aviation accident and incident reports. An analysis of the NTSB's database from 1 January 1983 to 31 May 1998 has revealed that about one in five accidents are caused by a fuel-related event. The majority of these accidents were precipitated by an in-flight fuel crisis event. Almost all of these in-flight fuel crisis events resulted in a loss of engine power in one or more engines. Investigation has shown that these in-flight fuel crisis events were predominantly caused by pilot error, with only a small fraction being attributed to mechanical failure of the engine or fuel system. These events are significant because they resulted in an estimated 2,000 fatalities over the 14-year period [1].

Perhaps alarmingly, in 43% of these events, the pilot ran out of fuel (fuel exhaustion). Of these fuel exhaustion events, 28% were due to lack of proper flight planning on the ground before take-off (pre-flight planning) and 28% were due to lack of proper in-flight planning (loss of fuel situation awareness) (see Table 1). Therefore, some 56% of the fuel exhaustion events were directly attributable to poor understanding of flight planning and the calculation of flight fuel required for the flight. In fact, some pilots did not undertake any flight planning; relying on previous experience instead [2]. This neglect obviously demonstrates a very poor flight planning ability and perhaps a fear of the complexities and difficulties of the flight planning process.

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Table 1: Summarised root causes of fuel exhaustion precipitated in-flight fuel crisis events.

| Root Causes of Fuel Exhaustion | Proportion |
|---|---|
| No accurate fuel check | 42% |
| Loss of fuel situational awareness | 28% |
| Inaccurate pre-flight fuel plan | 28% |
| Flying under the influence of alcohol | 1% |
| Mechanical | 1% |
| Lack of fuel system knowledge | 1% |

Therefore, it is worthwhile examining any educational methodology that has the potential to improve a student's understanding of flight planning as it could significantly reduce the probability of accidents and their associated loss of life.

In this article, the author introduces the Bachelor of Applied Science (Civil Aviation) (the aviation degree) offered by the University of South Australia in Adelaide, Australia, and describes a scenario-based approach to the teaching and learning of complex flight planning in the second year of the aviation degree programme.

## AVIATION DEGREE PROGRAMME

The aim of the Bachelor of Applied Science (Civil Aviation) is to prepare graduates for a career as a professional airline pilot. The degree meets the academic requirements of the relevant professional and regulatory bodies for recognition as an air pilot. The first year of the degree includes aeronautical courses up to the Commercial Pilot Licence level and includes courses in aerodynamics and aircraft systems, navigation and meteorology, aviation legislation and procedures, and flight planning and aircraft performance. The second year of the degree focuses on the aeronautical knowledge required to hold an Air Transport Pilot Licence. Courses in the second year include aerodynamics and aircraft systems, navigation and flight planning, human factors and meteorology.

Historically, students have found the second year aviation courses *Navigation and Flight Planning 1* and *Navigation and Flight Planning 2* extremely difficult; especially the latter. Student feedback through the Course Evaluation Instrument (CEI) has revealed that this is generally because the required knowledge base is large and difficult to comprehend. The CEIs also revealed that students regarded the workload as excessive for these courses when compared to the other courses in the second year of the programme. However, they did generally acknowledge that the workload was necessary for a proper understanding of the material. They also accepted that the knowledge and experience gained in these courses are essential for their future airline careers.

The course *Navigation and Flight Planning 2* requires an in-depth knowledge of navigation, flight planning, flight rules and procedures, instrument flying, aircraft performance, meteorology and aerodynamics. In fact, in this course, the student applies the knowledge gained in all of the courses studied up to this stage in the aviation degree programme. It is this holistic nature of the course that causes some concern to be expressed by students in the CEIs about the magnitude of the workload required by this course when compared to other courses in the second year of the Bachelor of Applied Science (Civil Aviation). Together, these courses provide the aeronautical knowledge requirements of five of the eight Civil Aviation Safety Authority's Air Transport Pilot Licence Examinations.

Managing student expectations, as expressed in the CEIs and the Student Evaluation of Teaching (SETs) is a crucial part of the learning process, and has stimulated the trial and subsequent introduction of scenario-based learning and assessment in these courses.

## COURSE STRUCTURE

The aim of the second year *Navigation and Flight Planning* courses is:

> *To provide the student with an understanding of global navigation charts, time zones, the knowledge to operate an aircraft under instrument flight rules; a knowledge of jet aircraft performance data and the additional knowledge and skills to enable planning and navigation of international flights using advanced flight planning techniques.*

The learning objectives for these courses are such that at the end of the second year, a student should be able to:

- Determine potential hazardous weather conditions;
- Plan an IFR flight following the correct departure, cruise and approach procedures;
- Explain the operation and limitations of radio navigation aids;
- Explain the types of navigation and aeronautical charts used on international flights;
- Convert global time zones to UTC, LMT, LST for any part of the world;
- Explain the altimetry procedures used on international flights;

- Describe and explain the procedure following an engine failure in flight in a multi-engine aeroplane;
- Interpret an instrument approach procedure from an instrument approach plate;
- Interpret an instrument departure procedure from an instrument departure plate;
- Explain and demonstrate advanced navigation and flight planning techniques for a path between two specified points in either hemisphere;
- Explain the use of visual, radio and instrument navigation techniques for both day and night flights;
- Calculate the maximum operating weight and corresponding speeds and levels for all stages of flight, using specimen performance graphs and charts.

In addition, there are University-defined Graduate Qualities that a student is expected to develop while undertaking these courses, and the programme as a whole. These are as follows:

1. *operates effectively with and upon a body of knowledge of sufficient depth to begin professional practice*
2. *is prepared for life-long learning in pursuit of personal development and excellence in professional practice*
3. *is an effective problem solver, capable of applying logical, critical, and creative thinking to a range of problems*
4. *can work both autonomously and collaboratively as a professional*
5. *is committed to ethical action and social responsibility as a professional and citizen*
6. *communicates effectively in professional practice and as a member of the community*
7. *demonstrates international perspectives as a professional and as a citizen* [3].

The essential topics covered in these courses include the following:

- Navigation techniques;
- Point of safe diversion;
- Point of equal time;
- Point of equal fuel;
- Route navigation;
- Flight progress charts;
- The compilation of long distance flight plans;
- Aircraft performance and methods of cruise control;
- The use of aircraft performance data, charts and graphs;
- Weight and balance, and the compilation of load and trim sheets.

Once a student has understood the fundamental techniques of flight planning, which is explained and presented as a body of knowledge in *Navigation and Flight Planning 1* and the first one third of *Navigation and Flight Planning 2*, a student is able to tackle real world situations and the problems associated with them. That is, the student is able to study a real situation involving a heavy jet passenger transport aircraft and then solve the flight planning problems associated with that situation. This will involve studying the weather at departure, destination and en route, studying the aerodrome runway distances, calculating the take-off, landing, climb, cruise and descent performance of the aircraft, and calculating the appropriate weight and balance of the aircraft; that is the loading of payload, including passengers.

Analysis of real world problems, especially those of a holistic nature, have a tendency to encourage self-directed learning and help develop professional piloting skills necessary for a student's future career. Thus, the further development of student learning within the course lends itself naturally to student-centred learning strategies. Further, it is generally accepted that to function efficiently in the complex aviation environment, it is essential to have developed sound flight planning skills. This will only occur through intensive practice involving real world situations and their associated problems.

Problem-based learning has been implemented widely in the engineering education domain especially in the area of student projects. Examples of this include Thomas, Hadgraft and Daly [4], Moesby [5], Vandebona and Attard [6] and Perfect, Kendrick, Armstrong and Lockett [7].

The benefits of experiential learning has also been discussed by McDermott, Nedic, Nafalski and Machotka [8]. They argue that student motivation for learning is increased by engaging the student in small project-based exercises.

The author has proposed Crew-Centred Flight Training (CCFT) as a team-based development of student-centred learning. This technique also uses a problem-based learning approach [9].

## FLIGHT PLANNING TECHNIQUE

The flight planning technique is explained in detail in a previous paper (see ref. [10]). Briefly, the process involves an iterative technique where the flight fuel is calculated a number of times, each time to a higher degree of accuracy. The reason an iterative approach is used for flight planning is because the rate at which fuel is consumed by an aircraft depends on the weight of the aircraft. Equally, the weight of the aircraft at a particular point on its flight path depends on the rate at which fuel has been consumed. Thus, the weight of the aircraft is dependent on the fuel consumption and the fuel consumption is dependent on the weight of the aircraft. This type of recursive problem indicates an iterative solution.

The iterative solution is usually started by making an estimation of the flight fuel required for the flight. This, together with the payload, determines an aircraft weight at take-off or landing. The flight plan is calculated using one of these weights and at the end of the flight plan, a new value for the flight fuel is determined. From this value of the flight fuel, a new start weight can be calculated and the flight plan worked again to derive another value for the flight fuel. The iteration continues until the difference in flight fuel between successive iterations is within 100 kg.

Mathematically, this is explained below.

Essentially, the weight of a turbine powered aircraft (*W*) determines the rate at which it consumes fuel (*dF/dt*). As the weight of the aircraft (*W*) decreases in flight, the lift, and hence the drag required to maintain altitude, decreases and therefore the aircraft consumes fuel at a lesser rate. Therefore, *dF/dt* is a function of *W*. Given that the flight fuel on board the aircraft can be as much as one third of the take-off weight of the aircraft, the weight of the aircraft (*W*) can change significantly during flight. Therefore, *dF/dt* will change significantly during flight.

Students use performance tables or charts to determine the rate of fuel consumption at a particular altitude, true airspeed and weight. Using the selected true airspeed of the aircraft and the wind direction (headwind or tailwind) the student can calculate a ground speed and time to arrival at the destination aerodrome (*T*). The fuel consumption rate, *C*, given by:

$$C = dF/dt$$

This can be used to calculate the flight fuel (*F*):

$$F = \int_0^T C\, dt$$

Therefore, as *F* is a function of *C*, *W* is also a function of *C*.

Therefore, from the above:

$$C = f(W),$$
$$W = f(C)$$

This situation lends itself to an iterative solution where an estimate of *W*, *W(0)*, can be used to calculate *C(i),* and *C(i)* can be used to calculate *W(i)*. The iteration stops when the error, $\varepsilon = (W_{i+1} - W_i)$ is within a prescribed amount.

The manual technique is implemented as follows.

An estimate of the flight fuel can be made giving consideration to the weather, altitude and temperature. The weight of fuel can then be added to the payload weight and the empty weight of the aircraft. This combined weight is the take-off weight of the aircraft. The take-off weight is then checked against the performance and structural take-off weight limits, and if the weight of the aircraft is less than either of these limits, the aircraft can take-off. Otherwise, the weight will have to be reduced by off loading payload until the take-off weight is equal to the limiting weight. A similar process can be followed for the landing weight. In order to keep the effect of weather constant, the flight is normally divided into zones which have approximately constant weather. An average aircraft weight can be calculated for each zone (estimated mid-zone weight) using either the start zone weight or end zone weight. The estimated mid zone weight can then be used to calculated the average consumption rate, $\hat{C}$. The ground speed can then be calculated from the true air speed and the wind effect. Given the distance in the zone the ground speed can be used to calculate the time to fly across the zone, *T*. The flight fuel for zone *j*, $F_j$, can be calculated from:

$$F_j = \hat{C}_j T_j$$

This is then repeated for all the flight zones. If there are *Z* flight zones, the total flight fuel for the $i^{th}$ iteration is given by:

$$F(i) = \sum_{j=1}^{Z} \hat{C}_j(i) T_j(i)$$

The flight fuel, *F*(*i*), can then used to calculate the take-off weight or landing weight of the aircraft, *W*(*i*), and if the error ε is low, the iteration is stopped and take-off and landing weights checked to see if they are still less than or equal to the performance limits for the runways or the structural limits of the aircraft. If the take-off weight and landing weight are within these limits, the flight is entered on to the flight plan.

For practical purposes, especially when doing the flight plan manually, the iteration is stopped after the second iteration. However, in order for this to occur, an accurate initial flight fuel estimate, *F*(0), is required to produce an initial estimate of *W(0)* for either the take-off weight or the landing weight.

## SCENARIO-BASED LEARNING

Once the fundamentals of flight planning are learnt and understood by the student in the first course, *Navigation and Flight Planning 1*, the student is exposed to real flight planning problems. For example,

> *You are en route from Melbourne (YMML) to Perth (YPPH) via Q58/J68. By ONS at 2210UTC, your position was on track and 739nm from YMML. This was a positive fix. Your Gross Weight at this time was 76,200 kg and you were cruising at Flight Level 310 at Mach 0.82. At 2225UTC, the no.2 engine was shut down due to low oil pressure. You decide to continue the flight to YPPH as it is a suitable aerodrome. What is the minimum fuel required at the positive fix to proceed to YPPH (including all mandatory fuel reserves)?*

Or:

> *You are en route from Sydney (YSSY) to Adelaide (YPAD) via H36. At Swan Hill (SWH), Air Traffic Control advise that you will be required to hold at Tailem Bend (TBD) at Flight Level 270 (FL270) for 20 minutes for traffic sequencing. In-flight data is SWH FL 310; Mach 0.8; Gross Weight 73,800 kg; wind 300°M/50kts; temperature -35°C. Forecast temperature at FL270 is -27°C. For the purposes of this calculation, the intermediate descent from FL 310 to FL 270 may be ignored. What is the expected average fuel flow and True Airspeed (TAS) while in the holding pattern?*

The weather is given to the student in the same format as it would be in a real situation.

Students are guided through examples of these types of problems in class. Students are also given numerous problems to practice and to solve in their own time. They can also create their own versions of these types of problems if they require more practice.

When students have covered a sufficient number of these elemental problems, which examine all aspects of the aircraft's flight performance envelope, the holistic scenario is introduced.

The holistic scenario is based on a complete flight scenario from the pre-flight briefing, to gathering weather and safety information (see Figures 1, 2 and 3), to loading the aircraft with payload and passengers (see Figure 4), to determining the route and flight levels to fly (see Figure 5), to calculating the fuel required for flight and emergency situations, to calculating the speed, heading and time intervals.

This involves a student processing a vast amount of information in an individualistic way with the intention of planning a safe and revenue-efficient flight. Given the large number of variables in each scenario, each flight plan is unique to the individual student. However, each flight plan is approximately similar within an acceptable envelope of variation.

Anecdotally, there is evidence that student learning is improved by using the holistic scenario-based method for teaching and learning. Students are more actively engaged in the learning experience and become more enthusiastic about solving real flight planning scenarios.

However, some students fail to adequately understand some of the individual elements of the flight planning technique and struggle with this methodology. Other students appear to understand the individual elements or problems but are unable to see the big picture and put all the individual elements together to form a larger problem or scenario. But on the whole, approximately two thirds of the class adapt well to the scenario-based approach.

## SCENARIO-BASED ASSESSMENT

Since the primary method of teaching and learning in the course is scenario-based, it seemed reasonable to infer that a scenario-based assessment would more accurately and effectively determine a student's level of learning. This was a departure from the normal forms of assessment in the courses within the UniSA's aviation programme.

In previous years, the final assessment of student learning in the advanced navigation and flight planning courses had been mediated by way of examination. This allowed an assessment of critically important aspects of aviation education: speed and accuracy. It also allowed an assessment of an individual's competence free from the risk of plagiarism. However, with the vast amount of knowledge that a student must learn and then be able to apply, one has to consider whether a three-hour examination can adequately assess all, or realistically even an adequate proportion, of a student's learning in the navigation and flight planning courses.

To this end, the project investigated a compromise assessment: the one-day assignment, which included beneficial elements from both an examination and an assignment. This was hypothesised to both adequately assess a student's level of learning in the courses and his/her ability to apply it to a real life situation or scenario. It also enabled some assessment of speed and accuracy as there was some realistic time limit

**Weather**

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FORECAST ROUTE SECTOR WINDS AND TEMPERATURES - PAGE 1
               BUREAU of METEOROLOGY - BRISBANE     07:13 UTC, 04/11/2006
----------------------------------------------------------------------
            ISSUE 040420              VALID 040300 - 040900
----------------------------------------------------------------------
FL -ISA YMML/YSSY YSSY/YBBN YMML/YPAD YMML/YMHB YPAD/YPOD/YMHB

445 -56 2905559   2504063   3005556   3004555   3005055 3004554
385 -56 2905056   2703056   2906553   3005552   2905552 3005051
340 -52 2905551   2802547   3007551   3107052   3006550 3106551
300 -45 3005041   2602536   3007044   3107045   3006545 3107046
235 -32 3004024   2402021   3005529   3005529   3005030 3005530
185 -21 3003013   3201011   3004017   3004517   3004018 3004519

FL -ISA YMML/YMDG/YBBN  YMML/YGTH/YWLG  YSSY/YMCO/YMHB  YSSY/YGTH/YPAD

445 -56 2905560 2504563 2905558 2705562 2905060 3004556 2805561 2906058
385 -56 2805556 2503555 2906555 2706555 3105057 3106053 2805056 2907054
340 -52 2806051 2702546 2907552 2705549 3105050 3106552 2805050 2907551
300 -45 2905041 2602536 3006042 2703539 3004539 3006544 2904039 3006542
235 -32 3004024 2402021 3105025 2802521 2903524 3005527 2903023 3105026
185 -21 3002512 3100511 3003514 3001510 3002512 2905016 3102011 3103514

FL -ISA YBBN/YBMK/YBCS  YWLG/27S148E/YBPNYSSY/28S149E28S149E/YEML/YBTL

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340 -52 2403043 2203039 2304545 2204041 2603047  2204043 2204040
300 -45 2502535 2302032 2302536 2203033 2702537  2202534 2103032
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185 -21 1700508 2101005 2500509 1801008 2801010  1800509 2001006

FL -ISA YBBN/25S148E/YBMAYBMA/YPDN YSSY/YTAM/YBMK  YBCS/YBMA YBCS/YHID

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340 -52 2403044 2304542 2202041   2602546 2303541 2203040   2501540
300 -45 2402535 2203533 2102031   2602536 2402534 2102531   2501530
235 -32 2202019 2102017 1701015   2402021 2402018 1901515   2600515
185 -21 1500009 1601006 1201503   2900510 1701007 1601004   1500503

FL -ISA YBBN/YSDU YSDU/VENEL/YPAD YSSY/APOMA APOMA/27S138E/YBAS

445 -56 2504563   2806061 2906058 2706062    2708563 2707565
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235 -32 3105026 3005023 2904521  2602517 1301015 2302020
185 -21 3003514 3003511 2903008  2901005 1101504 2900510
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Figure 1: Route sector winds and temperatures.

imposed on the solution of the problem. The assignment tested a student's knowledge using a scenario-based approach to a full-scale highly realistic flight planning situation.

## EXPERIMENTAL DESIGN

The students were given a typical flight planning scenario as shown in Figure 6.

The students were directed to refer to navigation chart ERC H2 (Figure 5) and plan a flight from Brisbane (YBBN) to Adelaide (YPAD) on 4 November at 0600 UTC. They were asked to consider all the weather information (Figures 1, 2 and 3) and carry 50 adult, 40 adolescent and 20 child passengers with their associated baggage and carry-on luggage. They were given some guidance to the seating of the passengers to ease the task of marking the assignment. They were directed to consider the abnormal operations involving a depressurised situation and an engine failure situation. This is the normal flight planning requirement. Given all these variables, they were asked to load the aircraft and plan the flight by the most appropriate flight route and altitudes. This presented the students with a very realistic flight planning and loading scenario.

In order to assess whether the examination technique of assessment or the scenario-based

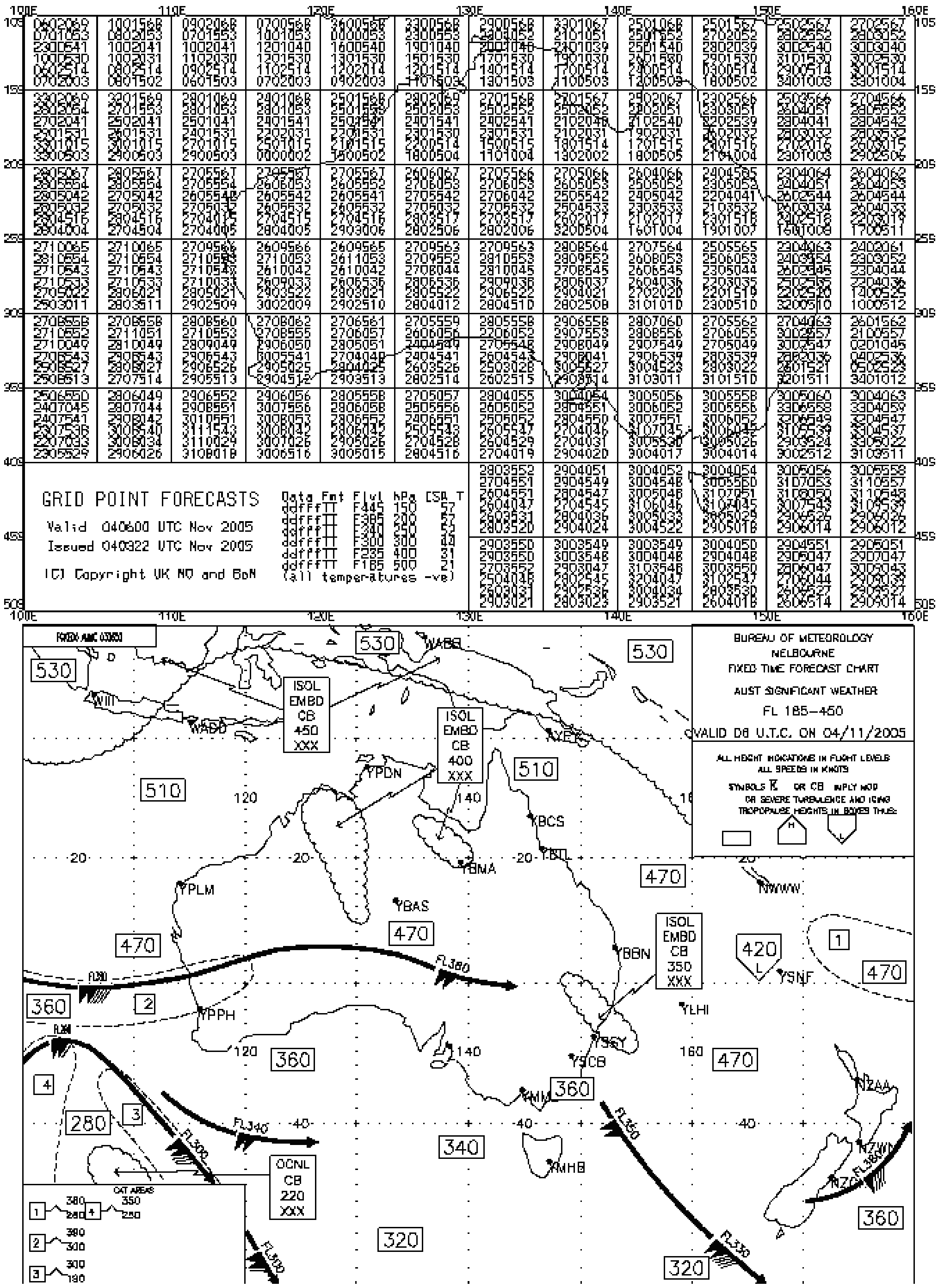


Figure 2: Grid point forecast and significant weather chart.

one-day assignment technique of assessment improved the assessment of student learning, the following methodology was applied. It was assumed, given the anecdotal evidence, that the use of scenario-based teaching improved student learning. This project investigated whether this learning was being assessed to the full extent. Therefore, it was concluded that if student results were improved by using the scenario-based assessment, then the full extent of learning in all areas was being accurately assessed.

Therefore, two hypotheses were formulated:

$H_0$: Using the scenario-based assessment had no effect on student results in *Navigation and Flight Planning 2*.

$H_1$: Using the scenario-based assessment had an effect on student results in *Navigation and Flight Planning 2*.

Two sample sets were extracted from the student results database for *Navigation and Flight Planning 2*. Sample 1 consisted of 61 students who had completed the course *Navigation and Flight Planning 2* in the three years immediately prior to the introduction of

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  FM08 16007KT CAVOK
  FM16 04010KT CAVOK
  FM02 33012KT CAVOK
  T 22 19 15 14 Q 1018 1017 1017 1017

  05:33 UTC, 04/11/2006
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      RMK RF00.0/000.0
      NOSIG

*MELBOURNE YMML
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  FM11 12006KT CAVOK
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  T 18 16 14 13 Q 1019 1021 1022 1022

  05:32 UTC, 04/11/2006
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      NOSIG

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  FM09 15010KT 9999 -SHRA SCT015 BKN025
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  T 20 20 19 19 Q 1019 1021 1022 1022

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  INTER 1224 3000 SHRA BKN012
  T 25 24 24 23 Q 1018 1020 1021 1020

  05:31 UTC, 04/11/2006
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      RMK RF00.0/005.2
      NOSIG
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Figure 3: Aerodrome forecasts.

the scenario-based assessment when the examination was used for assessment. Sample 2 consisted of 65 students who had completed the same course in the three years immediately after the introduction of the scenario-based assessment.

The student data was de-identified and an Analysis of Variance performed to determine, within statistical significance, whether or not the two samples were sufficiently different to have originated from two different populations.

## RESULTS

An analysis of variance (F test) was performed between Samples 1 and 2. Sample 1 had a sample size of 61 students and a mean mark of 57.4%, while Sample 2 had a sample size of 65 students and a mean mark of 66.1%. The degrees of freedom between the samples was 1 and within the samples 124. This gave a critical $F_{crit}$ value of 3.92 and 6.85 for a significance level, $\alpha$, of 0.05 and 0.01, respectively.

The calculated F value, $F_{obt}$, was 5.72. This value was greater than $F_{crit}$ of 3.92 ($\alpha$=0.05) and therefore we can conclude that the two samples did not originate from the same population with a significance greater than $\alpha$=0.05. In other words, there is a probability greater than 95% that the two samples were independent and did not originate from the same population (Table 2).

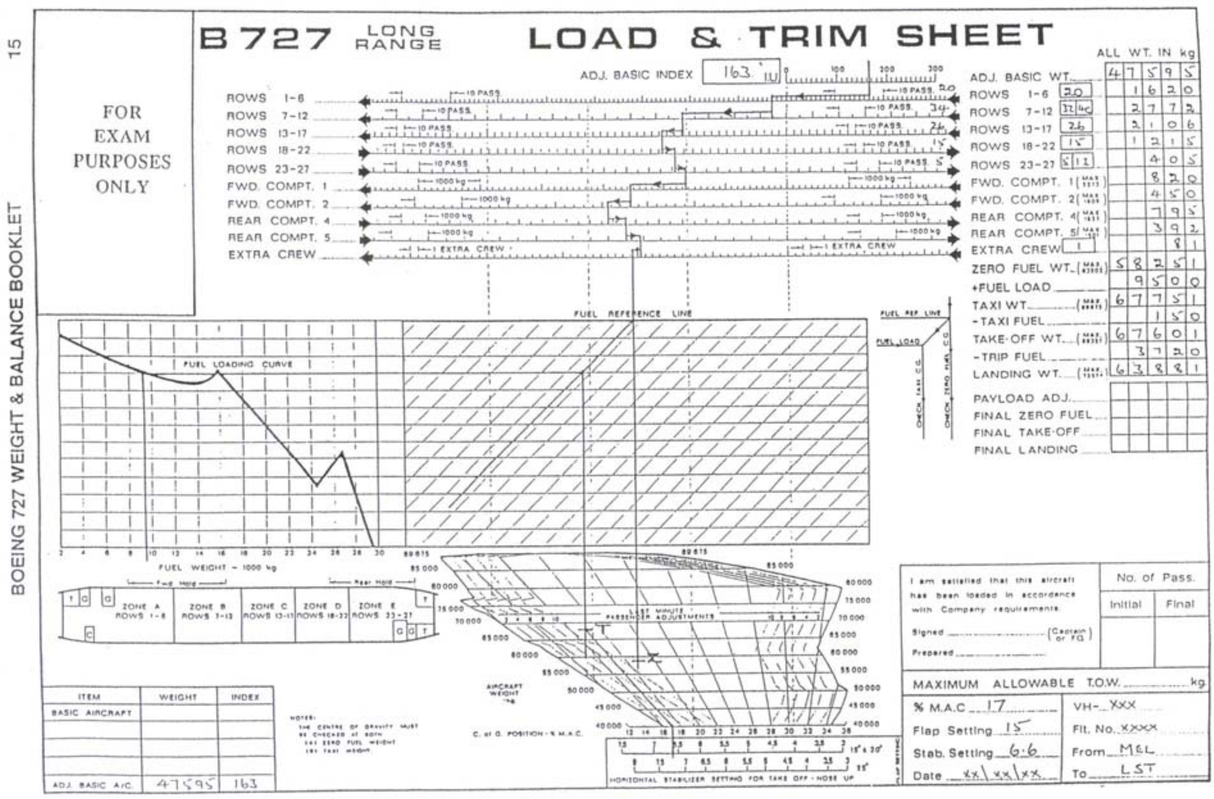


Figure 4: Load and trim sheet.

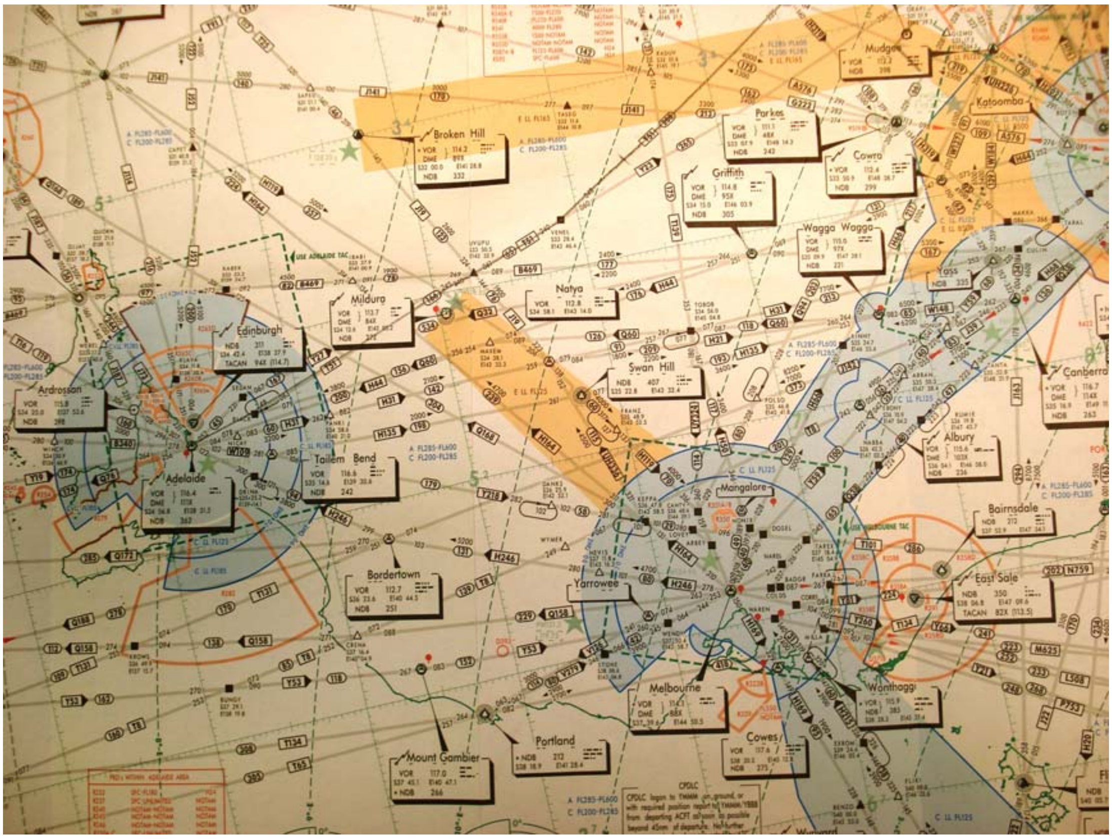


Figure 5: En route navigation chart.

Thus, the null hypothesis, $H_0$, is rejected and the conclusion is that the alternative hypothesis, $H_1$, is more likely. Therefore, the use of a scenario-based assessment technique in *Navigation and Flight Planning 2* did have an effect on student performance as judged by their final results (to a significance of $\alpha$=0.05). Further, it can be stated that, given the differences in the mean marks between the two samples, student results improved.

No other contributing factors that could have acted as independent variables were investigated. As the samples included student results across a six-year time span, there could have been more than one independent variable, such as variations to the delivery method and the delivery of complementary courses from year to year, which may have had an effect on the dependent variable, the students' final mark for the course

## CONCLUSION

Given the results of the analysis of variance (F test) analysis between the two sample sets extracted from the student results database over a six-year period, it would appear that the two samples did not come from the same population of student results to a significance of $\alpha$=0.05. Therefore, it was concluded that the use of a one-day assignment that was scenario-based did assess the students' learning to a deeper level.

It is clear from the means of the two samples that students scored higher marks in the scenario-based assignment than in the examination. This was most likely because it allowed a thorough assessment of the whole course rather than a smaller part of the course. This allowed lesser able students to achieve recognition for the elements of the course that they knew well. These elements may not have been assessed in the examination. Also, it could be that students performed better because they were able to apply themselves better to a real world holistic problem or flight planning scenario than in an artificial situation with a number of small unrelated problems as occurred in the examination format.

Student feedback indicated that the students preferred the one-day assignment to the traditional three-hour examination, even though the one-day

Table 2: Results of the Analysis of Variance.

| | n | Mean | Fobt | Fcrit $\alpha = 0.05$ | Fcrit $\alpha = 0.01$ |
|---|---|---|---|---|---|
| Sample 1 | 61 | 57.39 | 5.72 | 3.92 | 6.85 |
| Sample 2 | 65 | 66.08 | | | |

This flight refers to **ERC H2**

**Aerodrome Information & Flight Details**

Use highest FL's available for normal operations and 1 engine inoperative operations. Use FL130 for DP Operations.
Normal Ops. Cruise at Mach M0.80.
BEW 47,250 kg. BIU 165.

**YBBN, YPAD, YMML, and YSSY are available for use.**

*Use only these aerodromes*

**Questions**

1. Plan a flight from YBBN to YPAD on 4 November ETD 040600.

Plan to carry minimum fuel and maximum payload. If an alternate aerodrome is required flight plan via appropriate route and flight level. Use the TTF/METAR for the ambient conditions at YBBN

You are required to carry 50 Adult, 40 Adolescents & 20 Children (including 20kg of checked baggage for each passenger) and as many 150kg containers as possible on the flight? (Assume 15 Adults and 5 Adolescents sit in Rows 1-6 and where possible 1 Child sits between 2 Adults in the other rows.)

All working must be shown and easy to read. **A Normal Ops flightplan, the most critical abnormal Ops flight plan and a load and trim sheet must be submitted with your working.**

*(Note: If you cannot correctly argue whether DP OPS or 2E OPS is more critical you must do both!)*

**Please highlight your answers to the following on the last page of your exam book.**

MBRW= ____________ Min FOB @ BR= ____________

Maximum P/L= ____________ %MAC ____________

Stab setting ____________

Figure 6: Typical scenario-based assignment.

assignment assessed a considerably larger body of knowledge and required the students to undertake a significantly larger amount of work.

There was some concern that the improvement in the students' results may be dependant on variables other than whether the students undertook the scenario-based assessment. However, none of these was investigated. The technique of using scenario-based one-day assignments for assessment is being considered for implementation in other aviation courses that, because of their operational nature, would probably lend themselves naturally to this approach.

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## BIOGRAPHY

Steve Thatcher was a founding member of the team that introduced Australasia's first tertiary award course in aviation in 1985 at the University of South Australia's (UniSA) antecedent institution, the South Australian Institute of Technology. This established the aviation discipline in the Australasian region. He remains the longest serving aviation academic in Australia.

Mr Thatcher was also a founding member of the team that established the University's Aviation Academy in 1990, which became the first university in Australasia to own and operate a flight training school.

In 1993, he founded the Aviation Education, Research and Operations Laboratory (AERO Lab) to conduct research into aviation psychology, aviation human factor, aviation safety and aviation education. He is currently the Team Leader of AERO Lab.

He was a founding member of the Australasian University Aviation Association and served as its Secretary for a number of years.

In 2005, he successfully negotiated the SA Government Fixed Wing Shark Patrol Service for UniSA Aviation. The UniSA Shark Patrol provides a valuable community service and has provided graduate pilots with valuable flight time experience at a stage in their careers when it is relatively difficult to get flight experience. He recently won the Chancellor's Award for Community Engagement for the UniSA Shark Patrol.

He has qualifications in physics, psychology, education and aviation. He has been a Jackaroo in South West Queensland, a graduate engineer for British Aerospace (UK) and has lectured in physics, electronics and aviation. He holds a Commercial Pilot Licence and a Grade One Instructor Rating. He is also on the editorial and review boards of several journals and conferences.

He was recently awarded the UICEE's Silver Badge of Honour for *...distinguished contributions to engineering education, outstanding achievements in the globalisation of engineering education through the activities of the Centre, and, in particular, for remarkable service to the UICEE.*