SUPPORTING STUDENT LEARNING THROUGH INNOVATIVE TECHNOLOGY IN THE AVIATION CLASSROOM

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Abstract

This paper reports on the implementation of the new Flight Procedures Laboratory at Griffith University, Brisbane, Australia. This computer lab has been outfitted with hardware and software to support the student learning of flight procedures in a practical, task-oriented way. Data has been collected from the first cohort of students using this computer lab with a pre- and post-survey conducted. Student interviews were also conducted. Results from the survey as well as a description of the lab setup are included in this paper along with information about how this type of teaching facility may help our future pilots.

Introduction

Commercial pilots worldwide, and in Australia, have to pass several theory based examinations administered by the Civil Aviation Safety Authority (CASA) before receiving a flight licence. Griffith University offers related courses as part of its three year Bachelor of Aviation program, which can be accelerated and completed in two years. The volume of the content to be mastered is sizable though. In addition, the information varies in its degree of relevance to a particular flight and adds to the complexity of practical flight training.

For these reasons, Griffith University has introduced a three part core course series called Flight Procedures, which is recognised towards its Bachelor of Aviation degree. The content is a selection of all the highly relevant parts of information taken from the various theory examination syllabi, and it spans the entire spectrum from *ab initio* to advanced flight training information. It aims to focus the attention of the aspirant pilot on that information which is highly important and relevant for most flying, and to prepare the student for his/her forthcoming practical flight training.

This study focused on the first Flight Procedures course taught in Trimester 3, at the end of 2017 and the beginning of 2018. The course was taught as an intensive course over a period of four weeks. The nature of the class activities is what is unique in Flight Procedures as well as the laboratory component. This paper will describe the implementation of flight procedures training in the Bachelor of Aviation program and the setup of the unique laboratory that contains computers with everyday flying software as well as PebblePad, an ePortfolio system that allowed the students to complete tasks and reflect on their flying. Students were taught the theory of aviation in this lab, assisting them in having better command of flight theory to support improved or accelerated flight training in the future when they are completing the practical flight training course, or Graduate Diploma of Flight Management (GDFM).

Literature Review

This literature review will comment on the history of flight training as well as aviation education in a global context. Research around software used for teaching flight training will also be reported.

Flight Training History: Brief Overview

Flight training commenced in 1909, when Wilbur Wright started training United States Air Force (USAF) officers to become pilots (Barata & Neves, 2017). The completion of the training syllabus prior to solo flight lasted about three hours. The first standardisation of flight training was in 1916 when the Royal Flight Corps (predecessor to the Royal Air Force) established a flight training establishment at Cranwell in the United Kingdom. In the same year, both Portugal and France also commenced with flight training.

A century later, the boundaries of aviation training and education have expanded to include aviation education at the tertiary and postgraduate levels. Included in this aviation education are many secondary schools, colleges, flight training schools, universities and other institutions from across the globe. Importantly, the training and education presented is no longer limited to flight training, but it typically contains the underlying theory from subjects such as aerodynamics, meteorology, human factors and air law, as prescribed by a regulatory authority.

Current State of Aviation Globally

An abundance of commercial information has been published over the past few years to discuss the present and expected high growth in the aviation sector. The annual 20-year forecasts by both Airbus and Boeing are leading examples (Airbus, 2017; Boeing, 2017) with both companies forecasting high growth in the next few years. Of particular relevance is the expectation that 534,000 new pilots should be trained by 2036 (Airbus, 2017).

Both the aviation industry and academia are concerned, and many plans are presently being put into action to address the shortage. For example, Qantas launched the "Qantas Future Pilot Program" in December 2017, partnering with five major Australian universities to mentor aspirant commercial pilots from an earlier stage in their careers and secure talent for the future (Qantas Airways Limited, 2018).

Despite these efforts, a main obstacle to increase the production of pilots remains the enormous cost of training a pilot to fulfil all the requirements. For example, to study a Graduate Diploma in Flight Management at Griffith University, resulting in a Commercial Pilot Licence (CPL), will cost approximately $122,000. This figure excludes the cost of a type rating, which can be an even bigger figure depending on the type of aircraft for which the type rating is sought. Any successful initiative to reduce the cost of flight training could have a substantial overall impact on the global pilot shortage.

Previous Flight Training Research
There is a dearth of literature pertaining to flight training setup in computer labs although the use of computer labs as an aviation training device has been available for years, with previous research suggesting that these labs can be effective in both maintaining instrument rating currency and enhancing proficiency (Talleur, Taylor, Emanual, Rantanen, & Bradshaw, 2003). The Federal Aviation Authority (FAA) acknowledged its value in the regulation in 1997 to allow partial recognition of flight hours on these devices (McDermott, 2005). Thus, the setting up of a computer lab for students to receive some training at university has some benefit, although with limited research reported in the literature.

EPortfolio use for flight training also has had minimal research conducted in this area. Often the research reports on aviation as a small section in a larger project. This type of research is reported in Cameron (2012), where the project mentions aviation as part of a larger university-wide implementation, but not how it was used specifically. Another article (Botterill, White, & Steiner, 2010), reports how ePortfolios are used as part of a larger graduate attribute project, but not for aviation students specifically.

The Griffith University Solution
To assist in graduating high quality candidates for programs such as Qantas' Future Pilot Program, Griffith University has introduced a new "Flight Procedures" course series in 2017 to improve the quality of pilot education. The content is a selection of all the highly relevant information with sections taken from the various theory examination syllabi that spans the entire spectrum from *ab initio* to advanced flight training information. It aims to focus the attention of the aspirant pilot on that information that is highly important and relevant for most flying and to prepare the student for his/her forthcoming practical flight training.

The three important components embedded in the course are the course content, the teaching style and student assessment. Thus, a constructive alignment approach has been used for this course (Biggs, 1996; Biggs & Tang, 2011) as well as a backward design approach to the curriculum development (Wiggins & McTighe, 2005).

This initial course implementation of Flight Procedures taught students the process of conducting a flight and has been developed from the theory curriculum as prescribed by Australia's CASA, which is mandated with regulating aviation in Australia. This included aerodynamics, flight planning and performance, meteorology and air law (Griffith University, 2018). The single pilot flight exercises covered encompassed Visual and Instrument Flight Rules, in both day time and night time. A basic single engine aircraft and a complex single engine aircraft were used as the training platforms. Various practical components were embedded in the course, such as the use of checklists, the pilot operating handbook, and navigational charts. This Flight Procedures course consisted of 12 x two-hour laboratory sessions, in a computer lab, under the guidance of a suitably qualified instructor, who was a retired airline pilot. The aim of the Flight Procedures lab is to use the lab as a teaching tool to enhance the understanding and internalisation of critical operational procedures and theory. It aims to improve students' cognitive preparation for their forthcoming flight training, resulting in more efficient learning experiences in the air.

The following research questions were developed:

- What should be included in a flight procedures laboratory to assist aviation students?
- In what ways can PebblePad be used to support student learning in the flight procedures laboratory?

Methodology

The project used design based research as it provides a "systematic, but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation" (Wang & Hannafin, 2005, p. 6). This iterative process allows for the design, redesign and development of both the teaching and data collection methods for the Flight Procedures series of courses. Thus, this paper reports on just the first iteration with the one course.

There were several methods of data collection including an anonymous pre- and post-survey that was conducted in class to assist with responses, although participation was completely voluntary. From the 142 students enrolled in the course, 49.3% (n=70) completed the pre-survey, which was mostly about student background knowledge. The post-survey was completed by 57.7% (n=82) of the cohort and asked the students how many times they practiced flying the circuit tasks, what they found improved and how it assisted their improvement. It is important to note that not all students answered every question, so some of the percentages pertain only to the number of students who responded. Students were also asked if they uploaded the optional first video, and how this may have helped with their learning and about using online technologies as well as PebblePad and how it worked as a tool.

Seven short interviews were also conducted with students who gave permission. This allowed for in depth data to be collected and has given greater perspectives on the lab and the tasks students were given in class and for the assessment. These interviews were audio recorded and transcribed. The two tutors who taught in the course were also interviewed prior to the course beginning and then at the end of the course. These interviews consisted of asking about their background, and how they thought the course would be beneficial to students as well as how it was received throughout the course. These interviews were also audio recorded, then transcribed and finally coded for themes.

Students were also able to give permission for their individual work to be analysed for research purposes with 50 students giving permission who also completed the initial reflection section of the assignment. Ethics approval was gained for this study and all data collection methods prior to the commencement of the project.

Results

These results are based around the two research questions and have been presented in a way as to answer them.

Development of the Flight Procedures Lab

A lab was developed in 2017 to provide a facility where Flight Procedures could be taught. This lab was fitted with 25 desktop computer workstations, each with their own flight controls (Figure 1), called a Personal Computer Aviation Training Device. The computers were also configured with a commercial flight simulator programme called Microsoft Flight Simulator X loaded onto the computers, as well as software to record the screen. All classes were taught in this computer laboratory, and students had access to go in and practice when there were no scheduled classes.

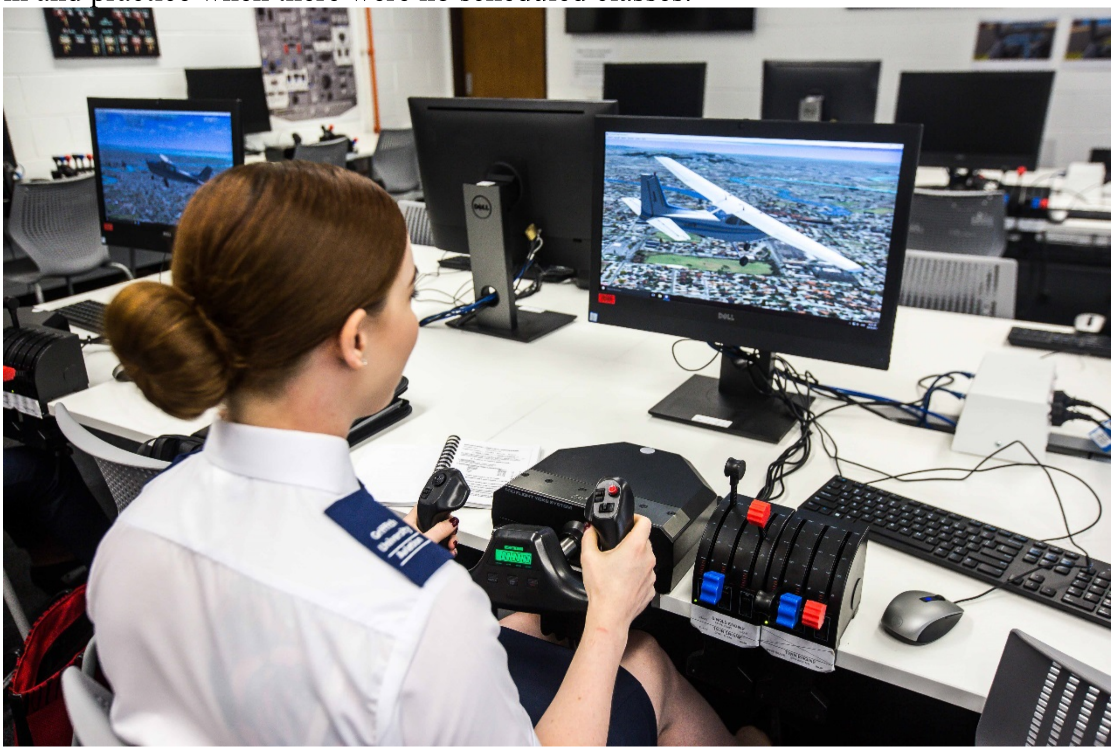

Figure 1. Using the simulator software in the Flight Procedures Lab.

As part of this Flight Procedures course the students were given specific tasks to complete using the software. Some of these tasks formed part of the assessment. However, there were other associated tasks that were not assessed. One such task was worth 30% of the final course mark and involved a Basic Visual Flight Rules (VFR) Circuit. After receiving a briefing on the flight circuit and having watched a demonstration video, students then had the opportunity to “fly” their first circuit during a laboratory session. They recorded their first attempt and then uploaded it into PebblePad. They answered seven reflective questions (see Figure 2). These questions have been designed to assist the students to focus on the critical thought patterns needed to fly quality circuits. This recording is not formally assessed, as it is meant to be used as preparation to assist the students to better understand the expectation for the formal assignment.

Following this session, students were able to complete four hours of supervised practise, and they were then able to practice as little or as much as they wished. Once ready, they were required to record and upload a final video that was assessed. PebblePad was used to upload the video both times and also had several reflective questions that students were able to answer in the final submission. Students were able to check their best display of flying skills and weakest display, which included items such as take-off, crosswind leg, downwind leg, base leg and final approach (Figure 2).

Best Display of flying skills

In the video, which of the following was the best display of your flying skills?

Please select

Weakest Display of flying skills

In the video, which of the following was the weakest display of your flying skills?

Please select

Checklist Flows

Order the following checklist flows from the most difficult (1) to the easiest (6) to learn to execute fluently:

	1	2	3	4	5	6
Before take-off checks						
Line-up checks						
After take-off checks						
Approach & landing checks				✓		
Final approach checks						
After landing checks						

Circuit Geometry

In pursuing good circuit geometry, order the variables below from the most difficult to easiest to control (1 = most difficult, 4 = easiest).

	1	2	3	4
Airspeed				
Heading				
Altitude				
Balance				

Connecting theory to practice

On the scale below, rate how difficult you found it to connect the theory you learnt in class with actually flying the circuit .

Extremely difficult ☐☐☐☐☐☐☐ Extremely Easy

Figure 2. Student reflection in PebblePad after initial video upload.

Students were also required to reflect on their flying after the final (assessable) video upload on topics such as describing air speed control throughout the different stages of the circuit, adjusting speed to maintain planned circuit geometry as well as which aerodynamic, regulatory or meteorological understandings informed speed control decisions. PebblePad allowed the process of uploading the video for submission as well as reflecting on the required questions easy to complete.

From the 70 responses to the pre-survey, 73% (n=51) were male and 27% (n=19) were female. The survey responses by sex were similar for the post survey. Of the 82 respondents, there were 73.2% (n=60) male and 26.8% (n=22) female. The results reported here are from the post-survey.

Students were asked if they were comfortable using online technologies for educational purposes with 92% (n=69) of the 75 respondents stating they either agree or strongly agree. Students also reported feeling confident when they use new online technologies for education with 88% (n=66) of the 75 respondents reporting they either agree or strongly agree. This indicates that these students are generally comfortable with new software, such as using the flight simulator software, recording their screens and then uploading the video into PebblePad. This should mean that students would spend less time learning and carrying out these tasks than if they were less comfortable and confident.

Students were asked about PebblePad, specifically about the workbook design, and they reported it was easy to navigate, with 81% (n=60) either agreeing or strongly agreeing. Students also found the workbook design had a logical structure with 81.3% (n=61) of respondents either agreeing or strongly agreeing. Overall, students felt that PebblePad was helpful to their learning with 70.3% (n=52) either agreeing or strongly agreeing with this statement. Students felt that it was a useful experience to learn how to use PebblePad with 63.5% (n=47) of students either agreeing or strongly agreeing. The students generally felt that PebblePad was easy to use with 79.3% (n=58) either agreeing or strongly agreeing. This suggests that PebblePad was a good choice of a platform for the location of the tasks, the video upload and for the assignment completion process.

Students reported noticing improvement when they practiced the circuit task with 96.3% (n=79) of the 82 students reporting this. Students generally reported their flying accuracy improved. However, some students were more specific with one stating "my circuit geometry and spacing, I got mor[e] used to my checks and felt comfortable" while another noted "altitude stability, looking when turning, more stable air speed" and yet another that s/he "noticed improvement in proficiency of completing checklists and maintaining speed, altitude, etc."

Yet another student stated:

> Improvement was made in the time I came in outside of class. I improved on my circuit overall as I was able to work under my own conditions and use the circuits maps provided to teach myself what speeds and flaps to maintain.

One of the tutors supported that the students were practicing out of class by stating, "I've been quite amazed about the amount of extra work the kids have been doing," with the other tutor commenting about "those who put the effort in" and that they are "showing a lot of interest."

The students were asked if they answered the questions when they uploaded the first video with 95% (n=75) reporting they did. This is reflected in the assignment data in PebblePad with most students answering most or all of the questions as well as uploading an initial video. The students were asked in what ways it helped with their learning with 62 students responding to this question. Students often recorded that it made them think about their performance or the actual task rather than just doing the task mindlessly. One student said, "Answering questions made me think more deeply about my performance and the various aspects I might not have thought of." Another commented, "It helped to prove the theoretical aspects of the course as you get to practice what you learn," which is quite positive.

There were a few negative comments that involved the idea that some focused feedback might have been helpful, "as I don't always know if I've done something wrong." However, tutors were in the room at regular times so they could have provided this feedback. Another student commented that it gave "a false sense of security regarding my performance regarding the upcoming assessment." This suggests the student may have been disappointed with the assignment grade. One student commented in depth by stating:

> It gave an indication to the direction of improvements that could be made with practice in the simulator, which could then be realised through repeated practice.

The students were asked to upload two videos, one at the beginning of the task and one at the end, which was the video used for the assessment process. The students were asked what worked well in terms of using PebblePad for uploading the videos with 75 responses placed into the survey tool. Overwhelmingly, student comments were positive about the upload with many students stating it made it easy to submit the assignment and that "everything worked pretty smoothly."

One student commented that "everything seemed to function logically and correctly" while another stated that "everything was easy to find, especially the video and the fact that you could watch your video while answering the questions," which allowed for ease to complete the final questions that were part of the assignment.

Limitations of the Flight Procedures Lab

It is not at all the intention of Griffith University that students entirely be taught to fly aeroplanes in this lab, but it is meant to be used as a teaching tool to enhance the understanding and internalisation of critical operational procedures and theory. It aims to improve student cognitive preparation for their forthcoming flight training resulting in more efficient learning experiences in the air.

Discussion and Conclusion

There are several key elements to creating a successful flight procedures computer lab. These include, computer work stations that include both hand and foot controls, software for flying, recording software, and ePortfolio software such as PebblePad to allow for scaffolded reflection.

In addition, the following guidelines ought to be designed to assist those implementing a Flight Procedures laboratory:

- Reflective questions should be designed to scaffold the students through a reflective thought pattern, thereby stimulating learning while self-discovering.
- The learning tasks are central to the Flight Procedures lab. Also, the peripheral material that each work station is equipped with, forms part of the learning toolkit. For example, a student has to calculate critical speeds by referring to the pilot's operating handbook and then apply them during the simulation exercise. This makes the learning journey realistic and challenging.
- Setting up the instructor work station correctly is critical. There needs to be access to the complete setup including the PowerPoint presentation, videos and supportive documentation for instructional purposes. This setup will allow for realistic live demonstrations of certain flight exercises as well as being able to record and play these back.
- Finally, a lab of this nature is reasonably space consuming and costly. It is important for all students attending class to have access to their own work stations, which may become a problem with larger student groups.
- Adequate provision for access to work stations should also be made after hours to make room for informal study and to practice the required assessment tasks.

Importantly PebblePad can be used to support student learning by providing tasks that can be taught, reflected upon and then practiced. It is reported here that students found PebblePad easy to use and that it assisted them in reflecting on their tasks and improving their assignment tasks through being able to practice. The two additional capabilities that PebblePad contributes to the Flight Procedures initiative are that it allows students to gather very specific, career-related ePortfolio data, which may provide them with a competitive edge for the future, and that it provides an easy way of tracking large and complex data quantities for research.

This paper describes an innovative computer lab set up for an aviation program at one Australian university. Various technologies included in the lab, and specifically the way they were utilised, have assisted with the lab becoming an early success. However, it should be noted that further research is warranted to ensure that the implementation is a continued success in the future.

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