A comparison of the learning outcomes of international students from Asia and Australian students in an undergraduate aviation programme

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ABSTRACT: A study was initiated to determine if cultural background had an effect on the learning outcomes of students in the aviation programme and to determine if there was a cultural effect on the learning of technical or non-technical flight skills. Four courses were selected; two with course material based on technical flight skills and numerical, problem-based assessment, and two with course material based on non-technical flight skills and essay-based assessment. Student results were divided into international students from Hong Kong and local Australian students to form two sample groups. It was seen that Hong Kong students perform better than Australian students when learning technical flight skills by way of numerical problem-based assessment. Australian students seem to perform better when learning non-technical flight skills by way of essay-based assessment.

INTRODUCTION

A literature search in the areas of aviation human factors or air crash investigation reveals that human error is the major contributing cause in aircraft accidents and incidents. One form of human error, inappropriate flight crew actions or in some cases flight crew inactions, was found to be responsible for some 70% of all accidents worldwide [1]. The literature indicates that the flight crew errors responsible for aircraft accidents were more likely to involve failures in team communication and coordination rather than failures in technical flight proficiency [2].

That is, flight crew errors are more likely to involve deficiencies in non-technical flight skills. However, in more recent times anecdotal evidence seems to indicate that flight crew errors in the technical flight skills area are on the increase. This may be due to the shifting of focus away from the learning of technical flight skills to the learning of non-technical flight skills. It is, therefore, important to deliver a curriculum which achieves a balance between technical and non-technical areas of learning.

It was with the intent of achieving this balance and creating a professional discipline of aviation, that the University of South Australia (UniSA) (through its antecedent institution the South Australian Institute of Technology (SAIT)) established Australia's first tertiary aviation qualification in 1985 [3].

PILOT EDUCATION AND TRAINING

Traditional flight training was conducted at small privately owned flying schools comprising one or two instructors or medium size flying schools comprising five to less than ten instructors. In the 1970's, a few larger private schools were established in Australia with ten or more instructors to cater for emerging airline pilot requirements. These flying schools usually offered a Commercial Pilot Licence course over 55 to 60 weeks of flight training. Only the larger schools offered theory subjects as part of the course. Almost all of the small to medium size flying schools provided no theory education or training and required the student to *buy the books* and self-study. This produced a student with limited theory knowledge and extensive *on the job* training was required once they were employed. Often, a student learned bad habits that were very difficult to unlearn *on the job*.

In the early 1980's, a group of academics from SAIT (now UniSA), and senior airline transport pilot practitioners from Ansett, Trans Australian Airlines (TAA) and QANTAS met in Adelaide, the Capital City of South Australia, at the Levels Campus of SAIT in order to discuss both the educational and training needs of airline pilots and, also, what the type of qualification would suit the aspirations of professional pilots. The view of the meeting was that pilots needed to be not only trained to be technically competent to fly an aircraft, but to be educated in all areas of piloting including

management, aviation psychology and human factors, educational processes and high technology aircraft control systems.

The programme that was eventually developed was the two year Associate Diploma in Civil Aviation. Later, this was expanded by one year of academic study and became a Bachelor of Applied Science (Civil Aviation) [3]. This programme provided an academically well balanced, integrated programme of aviation education and *ab initio* flight training. The programme was designed to graduate a *professional air pilot* who had the appropriate level of knowledge and aeronautical skill, essential in operating modern, high technology aircraft, as well as provide the basis for further professional development and progression to the many and varied supervisory, managerial and technical positions within the aviation industry [3].

RESEARCH IN AVIATION

Since the mid 1990's, educational research in aviation has been undertaken in the Aviation Education, Research and Operations Laboratory (AERO Laboratory). One of the *foci* of this was the development of a balanced curriculum in both technical and non-technical flight skills and, in particular, the improvement of student learning in these areas. This has included case studies in the areas of meteorology and human factors [4], and curriculum redesign in the areas of airline navigation and flight planning [5]. More broadly, the programme structure and method of delivery have been redesigned with a view to fully integrating the technical and non-technical aspects of the programme. This crew-centred flight training (CCFT) approach has not, as yet, been implemented [6].

One study in 2010, was conducted to investigate whether a student's learning, as determined by raw mark for the course, was affected by a student's awareness that the pass mark for the course would be set at 70% (a relatively high pass mark) [7]. The study was undertaken because the pass mark for the theory examination set by the licensing authority (Civil Aviation Safety Authority (CASA)) was a minimum of 70%. Furthermore, examinees are required to pass the appropriate theory examination prior to undertaking the practical flight examination in order to gain the pilot licence.

It was a study to determine the effect of students', rather than teachers', expectation. Research has indicated that schools can improve student learning by encouraging teachers and students to set their sights high [8]. However, this research showed that not all of a teacher's expectations are rewarded with favourable results; especially, when students come from vastly different backgrounds. A student's performance can in many ways be attributed, to some extent, to his or her background. In some countries where the culture dictates that hard work and effort are the key elements to success, high expectations are often held by students themselves and, if students do not perform well, the prevailing culture believes that the student has failed due to lack of effort, rather than lack of personal ability [8]. This suggests that there may be a cultural aspect to learning.

Research on the effect of national culture on a flight crew's interaction with advanced automation showed that there were attitudinal differences between national cultures. For example, the analysis of attitudes concerning a flight crew's interaction with the flight management computer (FMC) had marked national differences [9]. The willingness to use the FMC as a discretionary tool, and question the FMC's output, was more evident amongst nations which had a more individualistic, egalitarian-based society (e.g. Australia, USA). Whereas, flight crews from nations which had a more hierarchical national culture (e.g. many Asian nations) were more inclined to accept the authority of the FMC without questioning the FMC's output [9]. The conclusion was that national culture does influence attitudes towards automation, but it was the responsibility of the organisation to develop an integrated safety culture.

RESEARCH METHOD

The effect of culture on aviation safety and learning is of interest. With this in mind a study was initiated to determine if cultural background had an impact on the learning outcomes of students in the aviation programme, and to determine if there was a cultural difference in the learning of technical or non-technical flight skills. This study was timely as it would allow redesign of the curriculum to correct for cultural bias when the new programmes are being developed in 2014.

A convenience sample group comprising results from undergraduate students enrolled in the aviation programme in four courses over three years was obtained. The courses were selected such that there were two courses with course material based on technical flight skills and numerical, problem-based assessment, and two courses with course material based on non-technical flight skills and essay-based assessment.

The group of student results were divided into international students from Hong Kong ($m_1 = 168$) and local Australian students ($m_2 = 324$) to form two samples. Given that there were a significant number of international students from Hong Kong, it was considered a convenient way to derive two culturally diverse groups. The analysis used was an analysis of variance; namely, the F-test statistic, at $\alpha = 0.05$ significance level and $\alpha = 0.01$ significance level for the two culturally diverse sample groups.

Subsequently, each sample was divided in two sub-samples, one representing courses with learning in the technical flight skills area and the other representing courses in the non-technical flight skills area, to form four sub-samples in total. This is shown in Table 1 below.

Table 1: Sub-sample sizes.

	Hong Kong students	Australian students
Technical skills Numerical/problem-based	$n_1 = 91$	$n_2 = 161$
Non-technical skills Essay-based	$n_3 = 77$	$n_4 = 163$
Total	$m_1 = 168$	$m_2 = 324$

RESULTS

Analysis shows that the mean mark for international students from Hong Kong was $\overline{y_1} = 72\%$ and the mean mark for local Australian students was $\overline{y_2} = 69\%$. This is shown in Table 2.

Table 2: Sample means.

	Hong Kong students	Australian students
	$m_1 = 168$	$m_2 = 324$
	$\overline{y_1} = 72\%$	$\overline{y_2} = 69\%$

In Table 2, it can be seen that students from Hong Kong scored marginally higher on average over all. Whether this difference was significant or not was determined by the F-test statistic. The difference was found to be not significant at $\alpha = 0.01$ or $\alpha = 0.05$. See Table 3 below.

Table 3: F-test result of the two samples.

Fobt	Fcrit $\alpha = 0.05$	Fcrit $\alpha = 0.01$
3.15	3.84 (df 1,490)	6.64 (df 1,490)

Furthermore, F-test analysis was performed on the sub-samples to determine if there was a significant difference in learning outcomes between Hong Kong students and Australian students, based on the learning of technical or non-technical flight skills. Hong Kong students scored 78% on average, whereas Australian students scored 69% on average for learning related to technical skill acquisition. The assessment was conducted using numerical, problem-based assessment for both the midcourse assignments and final examinations. The Australian students scored 69% on average compared to 64% on average for the Hong Kong students, for learning related to the acquisition of non-technical flight skills. The assessment in this case was conducted by way of essay-based assignments. It can be seen that Hong Kong students performed better than Australian students when learning technical flight skills by way of numerical problem-based assessment. Australian students seemed to perform better than Hong Kong students when learning non-technical flight skills by way of essay-based assessment (Table 4).

Table 4: Sub-sample means.

	Hong Kong students	Australian students
Technical skills Numerical/problem-based	$n_1 = 91$ $\overline{x_1} = 78\%$	$n_2 = 161$ $\overline{x_2} = 69\%$
Non-technical skills Essay-based	$n_3 = 77$ $\overline{x_3} = 64\%$	$n_4 = 163$ $\overline{x_4} = 69\%$

An analysis of variance, F-test statistic, was used to determine if these differences were significant (Table 5).

Table 5: F-test results of the four sub-samples.

Sub-samples	Fobt	Fcrit $\alpha = 0.05$	Fcrit $\alpha = 0.01$
1 and 2	22.22	3.88 (df 1,250)	6.74 (df 1,250)
3 and 4	5.50	3.89 (df 1,238)	6.75 (df 1,238)

An F-test analysis revealed that for sub-samples 1 and 2, for the learning of technical flight skills, Hong Kong students performed significantly better at the significance levels of $\alpha = 0.05$ and $\alpha = 0.01$. For sub-samples 3 and 4, for learning

of non-technical flight skills, Australian students performed significantly better at a significance level of $\alpha = 0.05$ but not at a significance level of $\alpha = 0.01$ (Table 5).

DISSCUSSION AND CONCLUSIONS

The analysis showed that Hong Kong students appear to be significantly better than local Australian students at learning technical flight skills such as: navigation, flight planning, performance and loading. The difference was significant at better than the $\alpha = 0.01$ significance level. Whereas, local Australian students seemed to be better at learning non-technical flight skills, such as human factors, communication and research methods. This difference was significant at the $\alpha = 0.05$ significance level, but was not significant at the $\alpha = 0.01$ level.

The original study was devised in order to remediate cultural difference in the learning of technical and non-technical flight skills. Given the results, it seems that curriculum redesign to assist Hong Kong students is not warranted in the technical flight skills area.

However, there is perhaps another explanation that could clarify these results. The assessment of the learning of technical flight skills was achieved by way of numerical, problem-based assessment. It could be that this type of assessment is culturally suited to Chinese Hong Kong students. Conversely, the assessment of learning of non-technical flight skills was achieved by way of essay-based assessment. Given that the Hong Kong students were *English as a second language* students (ESL), with their first language Chinese (Cantonese), the explanation for performing less well than Australian students could be attributed to language difficulties. This may be indicated by a higher average mark ($\overline{x_1} = 78\%$) for courses involving numerical problem-based assessment, but a lower average mark ($\overline{x_3} = 64\%$) for courses involving essay-based assessment.

Another study examining the learning of technical and non-technical flight skills using multiple methods of assessment (both essay-based and problem-based) would help eliminate this possible extraneous effect. The new study could also examine courses in the technical area which have essay-based assessment of learning, and courses in the non-technical area which have problem-based assessment.

If there is any assistance needed to improve the learning outcomes of Hong Kong students, it could involve assistance with English language difficulties and essay writing skills. This is probably better achieved outside of the programme through help from the learning assistance centre.

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