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Author

Mizzi, Andrew, Lohmann, Gui, Carim Junior, Guido

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Aviation and Aerospace

**The Role of Self-Study in Addressing Competency Decline among Airline Pilots during
the COVID-19 Pandemic**

Andrew Mizzi^a, Gui Lohmann^b and Guido Carim Jr.^a

^aGriffith University, Australia

^bGriffith University, Australia &

Tourism Economics and Management Research Centre, University of São Paulo, Brazil

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Correspondence concerning this article should be addressed to Andrew Mizzi, School of Engineering and Built Environment – Aviation Discipline. 170 Kessels Road, N79 Building, Level 3, Nathan Campus, Queensland, Australia. Email: andrew.mizzi@griffithuni.edu.au

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The Role of Self-Study in Addressing Competency Decline among Airline Pilots during the COVID-19 Pandemic

Abstract

Objective: This study aimed to investigate the self-study methods used by pilots while grounded and their perception of competence decline and confidence upon their return to flying.

Background: Previously, long absences from flying were managed on a case-by-case basis. Thousands of pilots returning to flying as the pandemic eases has placed a burden on airline training systems. Limited research has been conducted on the decline in skills of airline pilots while operationally absent from the cockpit. Few studies have considered this topic in the context of a pandemic.

Method: A questionnaire study was conducted with 234 airline pilots who were grounded during the COVID-19 pandemic.

Results: Uncertainty regarding sudden and indefinite periods of grounding made it challenging to maintain motivation to self-study. This matter was aggravated by the additional financial and personal stress caused by the state of the airline industry and the outcomes of the pandemic. The participants anticipated a decline in manual flying skills as the worst outcome after being absent from the flight deck. However, these pilots proved quick to recover these skills when they resumed flying. It took significantly more time for pilots to regain proficiency in applying knowledge, procedures, compliance with regulations, situation awareness, and workload management.

Conclusion: The study proposes recommendations for pilots and airlines to harness essential self-study practices in competency areas identified to have significantly declined.

Application: The outcome of this paper guides airlines, pilots and regulators in better understanding how grounded pilots observe skill decline in a broader range of competencies.

Keywords: flight proficiency, training evaluation, competency-based training, skill retention, distance learning

Précis

COVID-19 has led to thousands of pilots being grounded. Research has been conducted on the decline in the skills of airline pilots who have been operationally absent from the cockpit. We propose recommendations for airlines, pilots and regulators in key areas associated with critical high-performance competencies.

The Role of Self-Study in Addressing Competency Decline among Airline Pilots during the COVID-19 Pandemic

The decline in aviation activities due to the spread of COVID-19 has been unprecedented. In April 2020, 66% of the world's commercial air transport fleet was grounded, as governments closed borders or imposed strict quarantines and passenger demand dropped (IATA, 2021a). As a result, thousands of airline pilots have been grounded, furloughed, or made redundant worldwide, leading to a loss of their operational recency and thus their operational proficiency. FlightGlobal (2021) published research from 2,598 pilots finding that 47% were unemployed or furloughed. The COVID-19 pandemic has brought additional hurdles for pilots regarding skill retention, including limited access to training resources due to social distancing measures, lockdowns, and border closures.

The International Civil Aviation Organization (2010) sets forth the international standards for pilots' recent experience requirements. State regulators, industry bodies and self-imposed regulations form the basis of an airline's training system. Normally, refresher-training requirements are based on the duration of the pilot's absence. The longer the pilot has been away from the cockpit, the lengthier and more detailed the training requirements. However, airline training systems and regulatory requirements were not designed to manage large numbers of airline pilots regaining their proficiency after long periods away from work. The profession also relies on voluntary training activities instigated by pilots in their own time. This self-study practice can involve reviewing various operating, technical and procedure manuals; safety material; and routes and airports.

Olaganathan and Amihan (2021) found an increase in flight safety incidents reported by pilots during the pandemic that were attributed to a decline in proficiency. Their findings suggest that regulators' training requirements and airline training programmes do not address actual training needs during a pandemic when large numbers of pilots were stood down. As

passenger travel resumes, the need to support large groups of pilots in regaining their proficiency has become a priority in operational recovery. Regulators, such as the Hong Kong Civil Aviation Department, can require costly base training to be completed following a two-year absence from flying (HKCAD, 2021). In its post-COVID-19 training guidance to ensure pilots' proficiency or competence when returning to work, the IATA (2020a, 2020b) emphasises four pilot competencies: 'application of procedures and compliance with regulations', 'aeroplane flight path management – manual control', 'situation awareness and management of information', and 'workload management'.

Given the context of the pandemic and the industry adopting various refresher-training models, the purpose of this study was to evaluate what grounded airline pilots have done to preserve their skills through self-study. The study also aims to understand where competency decline has occurred and how these self-study practices and airlines assist in returning crews to operational status.

Skill Retention in Airline Pilots and the COVID-19 Pandemic

Research into pilot proficiency has generally focused on perceptual motor skills, otherwise classified as manual flying skills, which is the most studied topic regarding the retention of pilots' skills. Studies conducted by Mengelkoch et al. (1971), Wright (1973), Ebbatson et al. (2010), and Casner et al. (2014) all found correlations between a decline in manual flying skills and a period of absence from flying. However, the current role of an airline pilot requires a broader range of skills than just this 'stick and rudder' or hard skills proficiency. Research on a broader set of pilot skills found that cognitive and procedural competencies deteriorated more rapidly than handling skills. Childs and Spears (1986) found that correctly identifying cues and classifying situations proved difficult for participants after a long flight absence. Additionally, Hendrickson et al. (2006) found that extending the

interval of recurrent training from six months to one year led to a decay in pilots' skill and knowledge.

The development of the concepts of evidence-based training (EBT) and competency-based training and assessment (CBTA) by the ICAO (2013) and IATA (2021b) required the reclassification of a range of hard and soft skills into competencies. Competencies are the unit of pilot performance manifested through knowledge, skills, and attitudes. Few empirical studies have addressed the use of EBT or CBTA in airlines. Only in March 2021 did the supranational regulator European Union Aviation Safety Agency publish its final EBT regulation (EASA, 2021). McCarthy and Agnarsson (2018) found that EBT performance indicators were superior to other training assessment models and that 'leadership and teamwork', 'communication', 'problem solving and decision making', and 'workload management' were key competencies that helped high-performing crews in simulated experiments. Understanding the retention of competencies is necessary for airline training departments to develop competency retention programmes.

A meta-analysis study by Driskell et al. (1994) yielded strong evidence that cognitive rehearsal improves task performance. Hendrickson et al. (2006) suggested that mental rehearsal would be helpful when incorporated more regularly into a pilot's routine. Study group collaboration has been recognised as a valuable and favourable study method (Gaytan & McEwen, 2007). Gully et al. (2002) found that team collaboration creates a sense of confidence in the face of adversity, an attribute that has become recognisably needed during the pandemic. Kramarski and Dudai (2009) found that combining this social form of training with guided learning increased metacognitive monitoring and achievement. This combination could also assist in relieving the effect of isolation among pilots due to the COVID-19 pandemic (Vuorio & Bor, 2021; Wilson et al., 2021).

The COVID-19 pandemic has led many pilots to face stressors that influence their motivation for continued self-study. This has partly been due to the personal and financial stress caused by the effects of the COVID-19 pandemic in the air transport sector. Peyrat-Guillard and Grefe (2020) found that while pilots idealise their employing airline, this bond is fragile, particularly in the face of being grounded or furloughed. Majuarsa (2021) established that a positive work environment positively affects pilot professionalism, and that the profession seeks to continually create and improve its professional quality. Leveraging this professionalism trait, airlines have placed expectations on their pilots to study, even though these pilots have been grounded without pay in many cases. As airline commercial pressure can increase precarious employment and lead to a decline in airline pilots' professional standing (Fraher, 2019; Fraher & Gabriel, 2014; Maxwell & Grant, 2021), a prolonged grounded period may lead to many pilots reconsidering their future in the industry. This trend may cause motivation to maintain skills to wane if airlines do not intervene.

Research Methodology

An online survey was conducted to gather data from participants. The survey method allowed for access to a large participant group from many countries, which was particularly useful given border closures and travel restrictions. The participants completed the survey anonymously. As only grounded pilots were targeted, the inclusion criteria were airline pilots who, during the COVID-19 pandemic, had not flown for at least 90 consecutive days as per the ICAO (2010) requirements and were required to undergo refresher training before returning to active operational status. The research complied with the American Psychological Association Code of Ethics and was approved by the Human Research Ethics Committee at Griffith University. Informed consent was obtained from each participant.

Questionnaire Design

The participants were asked to describe the study methods they had used in a typical month, their motivation towards voluntary self-study and how the pandemic impacted their study activities. The participants who had returned to line-flying duties were asked additional questions regarding their competencies that may have faded. The IATA's (2021b) pilot competency model was used to measure these skills. To guarantee that the participants could understand the competencies to self-rank their decline and recovery, a specific explanation of the nine competencies was provided in the questionnaire, and the participants' familiarity was measured. The participants self-ranked how their competencies were *anticipated* to have declined while grounded and how they prioritised their self-study activities to these competencies. They then self-ranked how their self-reported competencies *actually* declined upon their return to flying. The self-ranking technique is common in aviation, particularly in debriefing sessions (Dismukes et al., 2000), where pilots judge their own performance for further review by peers and instructors. The participants were finally asked how many flights it took for those competencies to return to a confident level of application. Open questions were used to understand self-led training and resources provided to grounded pilots while inactive, how this influenced the recovery of declined competencies, and the structure of airlines' training once they returned to flying. The participants who were grounded for an extended duration, defined as six months (double the consecutive 90-day ICAO (2010) requirement), answered questions related to how airlines managed their operational return.

Data Collection

The survey link was shared through the authors' LinkedIn network and industry-specific groups on this social media platform, such as the Royal Aeronautical Society's Human Factors Group, Flight Safety Foundation, and Human Factors in Aviation. The Australian and European pilot unions and two airlines shared the survey link with pilots via email. The questionnaire was available for participation in August 2021 for 30 days.

There were a total of 234 participants providing valid results. Approximately 55% (n = 129) of the pilots had not returned to line-flying duties and responded to questions related only to the use of study methods. Those pilots who had returned to flying (45%, n = 105) also provided information on their decline in competency and return to active operations.

Respondent Profiles

The highest proportion of pilots within the sample were Australian (39%, n = 92), and there were many participants from Hong Kong (25%, n = 58). This was influenced by the recruitment of participants via an Australian pilot union and a Hong Kong airline. Most participants held the highest level of licence (air transport pilot licence - 89%, n = 209), and the average total flying experience of the respondents was 10,461 hours (SD=6,267). This indicates that the participant sample was composed of experienced pilots. The participants had flown on average 3,793 hours (SD=3,463) on their current aircraft type. The average expectation of grounding duration held by the participants was seven months (SD=9). The most frequent participant response (25%, n = 60) indicated that they did not expect to be grounded at all. The participants indicated they had been grounded on average for 12 months (SD = 8). Some (13%, n = 30) had been grounded longer than 18 months, which would include those on annual or medical leave and those impacted by the pandemic.

Data Analysis

The results were analysed using Tableau, Excel, and SPSS. Open-ended questions were analysed through NVivo. Table 1 shows the analysis completed on several hypotheses.

Table 1

Hypotheses Tested

Null Hypothesis	Variables	Test
Pilots completed self-study in the lead-up to their return to operational status	Ind: Pilots who had returned to operational status. Dep: Pilots who completed self-study while grounded.	Chi-square
Pilots who had not expected to be grounded placed little emphasis on self-study due to this uncertainty.	Ind: Pilots who did not expect to be grounded. Dep: Pilots who did not complete self-study while grounded.	Chi-square

Guidance or training packages from the airline influenced pilots to complete self-study.	Ind: Pilots who received guidance or voluntary training packages from their airline. Dep: Pilots who completed self-study while grounded.	Chi-square
Pilots could accurately assess the decline in their skills while absent from the cockpit.	Ind: Pilots reported ranking of expected/anticipated competency decline. Dep: Pilots reported ranking of actual competency decline.	Wilcoxon signed-rank

The chi-square test (Lavrakas, 2008) at a specified .05 statistical significance level was used to measure the associations among nominal data. The Wilcoxon signed-rank test was used to measure the matched pairs of competencies when comparing anticipated versus self-reported decline in competencies (Rosner et al., 2006). Weighted averages of anticipated and self-reported competency decline were used to understand which competencies received greater emphasis from participants. Of the nine competencies being measured, a weight of ‘9’ was given to the competency that declined the most, and a ‘1’ was given to the competency that declined the least.

Results

Study Habits During a Period of Absence from Flying

The participants were asked whether their airlines set any explicit or implicit self-study expectations while grounded. Approximately 69% of participants (n = 156) said no explicit expectations were placed on them. However, implicit expectations influenced the participants’ study habits. As explained by one participant, “*Regardless of the company providing training opportunities, the pilots are required to demonstrate a high level of self-discipline and pursue self-study on their own initiative, sort of like a professional ethos*”. A small number of participants stated that they were expected to complete computer-based or online training (16%, n = 37) and remain up to date in terms of notices to crew/procedural changes (5%, n = 12). Most participants (75%, n = 174) did not receive any self-study programmes or voluntary training opportunities from their airlines.

The research found that almost half of the participants (45%, n = 106) had not completed any voluntary self-led study activities while they were grounded. To understand

the influences of the lack of study activity, three hypotheses were tested. The null hypothesis that the participants who completed the self-study were those who had subsequently returned to active flight operations was rejected ($\chi^2(1, n = 234) = 0.14, p = .70$). Furthermore, the null hypothesis that the participants being unexpectedly grounded in the first place (26%, $n = 60$) would negatively influence self-study activities was also rejected ($\chi^2(1, n = 226) = 0.59, p = .44$). Receiving study guidance or voluntary training programmes from their airlines during the grounding was also not correlated with those who studied while grounded ($\chi^2(1, n = 234) = 2.04, p = .15$)

Of the participants who completed self-study while grounded ($n = 128$), 31% ($n = 40$) reported their study effort increased whilst grounded compared to when they were normally operationally flying. The study of operating and procedural manuals was rated as the most common method used, with 40% ($n = 51$) of the respondents stating that they used it at least once per week. Cognitive rehearsal was conducted by 66% ($n = 84$) of the participants but less frequently. The participants mentioned that cognitive rehearsal was useful for studying procedural flows and memory items: *“Armchair flying maintained my memory of the normal flow of a flight, including pre-flight tasks”*. More than half (52%, $n = 66$) of the participants completed the computer-based training study. Group study sessions were used by 17% ($n = 22$) of the participants in this study. However, social distancing measures limited access to this approach in many cases. Home flight simulation more than once per week was also a popular method used by 23% of the participants ($n = 30$).

Several themes emerged concerning stressors influencing the participants' study activities during the pandemic. Social distancing and border closure measures had some influence on how the participants studied. These measures restricted 22% of the participants ($n = 52$) from conducting self-study activities that they otherwise would have due to closed or limited access to training facilities. The pandemic led to significant financial and personal

stress among many pilots. Some common narratives described by pilots were as follows:

“Mental and financial stress, uncertainty over [the] tenure of employment” and the “disengagement and anger most are carrying around are also not addressed. The human element has been overlooked”.

While some had undertaken other types of employment, 80% (n = 188) still sourced their primary income from their work as airline pilots, waiting to return to operational status. This led to their motivation varying significantly in terms of self-study. As one participant described, *“During the first 6-12 months of stand down, I felt zero interest in study or preparation for my eventual return to flying. I felt [a] disconnect and disengaged from the airline and felt frustrated”*. Skill-similar employment was undertaken by 18% of the participants (n = 42) through flight instruction, human factor training, and piloting unmanned aerial vehicles.

Perception of Decline in Proficiency During a Period of Absence from Flying

The participants individually ranked the competencies they anticipated to decline due to the absence from flying. The result was then compared to how the participants perceived their competency decline preceding their return via the airline training system. This comparison was used as the measure of skill atrophy experienced by pilots due to grounding during the pandemic. Most participants (90%, n = 94) were familiar with the competency markers being utilised, indicating that it was well understood as a measurement tool for the questionnaire.

The results indicated that ‘flight path management – manual control’ was the most frequent competency anticipated to have declined. In contrast, there was a broader distribution of participant responses in terms of self-reported competency decline, indicating an underestimation of the decline in skills by the participants.

When comparing decline in competencies self-reported by the participants, the results in Table 2 show that whereas ‘application of procedures and compliance with regulations’ and ‘aeroplane flight path management manual control’ were perceived to have declined less than expected (indicated by a higher ‘anticipated’ versus ‘self-reported’ mean), the pilots accurately predicted their ‘workload management’ would decline, but not in scale to other competencies (indicated by differences in variance). In contrast, ‘situation awareness and management of information’, ‘aeroplane flight path management automation’, ‘problem solving and decision making’, ‘communication’, and ‘leadership and teamwork’ declined more than expected. A Wilcoxon signed-rank test was conducted to confirm the hypothesis that for each competency, the participants could accurately anticipate their skill decline, which was disproven for all competencies except ‘workload management’ (Table 2). Statistical significance was found only for ‘communication’ and ‘leadership and teamwork’ competencies (p value $<.05$), as there was a larger difference between the anticipated and self-reported assessments.

Table 2

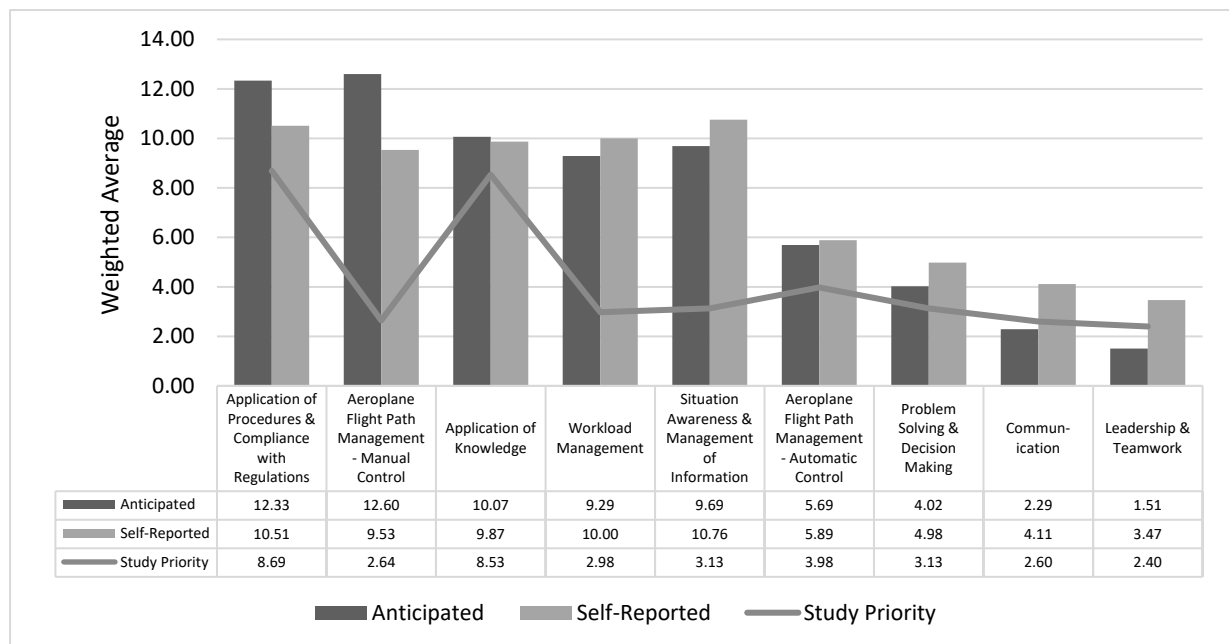
Wilcoxon Signed-Rank Test of Perception of Anticipated versus Self-Reported Decline in Competencies

Competency	Variable	Mean	Variance	Std. Dev	Median	p value	Z
Application of procedures and compliance with regulations	Anticipated	8.67	69.50	8.34	6.00	0.611	-0.509
	Self-Reported	8.00	30.50	5.52	7.00		
Aeroplane flight path management manual control	Anticipated	8.22	114.94	10.72	5.00	0.905	-0.119
	Self-Reported	7.56	29.78	5.46	6.00		
Application of knowledge	Anticipated	7.44	34.28	5.85	8.00	0.671	-0.424
	Self-Reported	8.00	24.25	4.92	7.00		
Workload management	Anticipated	7.22	24.69	4.97	10.00	1.000	0.000
	Self-Reported	7.22	43.94	6.63	5.00		
Situation awareness and management of information	Anticipated	6.78	49.69	7.05	5.00	0.438	-0.775
	Self-Reported	7.78	45.69	6.76	4.00		
Aeroplane flight path management automation	Anticipated	4.33	12.75	3.57	4.00	0.203	-1.272
	Self-Reported	6.00	9.00	3.00	6.00		
Problem solving and decision making	Anticipated	3.44	10.03	3.17	2.00	0.235	-1.188
	Self-Reported	5.33	12.50	3.54	6.00		
Communication	Anticipated	1.67	2.50	1.58	1.00	0.026	-2.219
	Self-Reported	5.33	20.00	4.47	4.00		
Leadership and teamwork	Anticipated	1.56	1.28	1.13	1.00	0.024	-2.252
	Self-Reported	4.78	12.94	3.60	4.00		

To further understand how perceived anticipated versus self-reported competency decline were ranked, the weighted mean is shown in Figure 1, in addition to weighted mean data that show how the participants indicated which competencies were targeted for self-study. It shows that ‘application of procedures and compliance with regulations’ and ‘application of knowledge’ received the greatest emphasis for study activity from the participants.

Figure 1

Weighted Average Ranking of Perceived Anticipated versus Self-Reported Decline in Competencies and How Participants Prioritised the Study of Competencies.



Return-to-Operations and Airline Training Programmes

The measurement of the number of flights it took for pilots to regain confidence in their declined competencies is shown in Table 3. More than three-quarters of the participants reported a confident application of all competencies returned within six flights. ‘Workload management’ stood out as an outlier in the number of flights required to regain confidence in its application. Degradation in this competency is colloquially known as ‘getting behind the

aircraft’, particularly in combination with degraded ‘situation awareness and management of information’.

Table 3

Number of Flights Required to Regain Confidence for each Competency

Competency	Up to two	Three to four	Five to six	Seven to eight	Nine to ten	More than ten
Application of procedures and compliance with regulations	19	18	15	5	--	10
Application of knowledge	12	23	15	2	4	8
Situation awareness and management of information	17	15	14	7	4	5
Aeroplane flight path management manual control	20	20	9	2	5	6
Workload management	12	13	19	7	2	5
Aeroplane flight path management automation	26	10	7	2	2	2
Problem solving and decision making	11	10	9	3	2	4
Communication	24	8	2	1	1	1
Leadership and teamwork	17	8	3	2	--	3
TOTAL	158	125	93	31	20	44

In total, 105 participants had been grounded for an extended period (longer than six months) and provided responses regarding their return to operational flying. The most common refresher training provided to the participants upon their return to operations was classroom and simulator training. Classroom training generally involved human factors, mental health welfare and familiarisation with revised company procedures. The majority (64%, n = 64) of this subsample received some simulator training, supplementary to the regulatory requirements. However, 15% (n = 15) reported that refresher programmes insufficiently prepared them to regain confidence. The participants mentioned that airlines were only training to the minimum required by their state regulators: “*Trained minimum competence, not confidence*” and “*there was very little scope to let me develop confidence*”.

The majority (61%, n = 62) of participants described that the environment produced by the COVID-19 pandemic increased operational complexity, causing distractions to proficiently execute flying competencies. Such distractions included complying with various

health screening protocols and airline operational changes, using personal protective equipment and the threat of quarantine. Airport facility closures, such as some runways or taxiways for aircraft parking, and reduced air traffic increased the threats for the crew.

Discussion

Competency Decline and Retention

The disconnect between grounded pilots and their employing airlines has a significant influence on skill retention. While some airlines have tried to motivate and engage their grounded pilots, the influence of the pandemic and uncertainty of when they will return to flying has hampered such efforts. This research showed that stressors have played a large role in demotivating grounded pilots for self-study. While airlines have focused on providing mental health support to pilots who have returned to operations via classroom training, pilots who are not actively engaged in training with their airline might have not received the required support.

The participants most often ranked ‘flight path management – manual control’ as the competency that declined the most. Despite being one of the least practised skills while grounded, over half of the participants reported a confident recovery in this competency within the first four flights. This result extends previous research by Childs and Spears (1986), Mengelkoch et al. (1971), and Ebbatson et al. (2010), showing that under COVID-19 pandemic conditions, perceptual motor skills are less prone to decline than cognitive skills and provides new evidence concerning the time required to return these skills to competence.

The regular study of operating and procedural manuals provided the easiest access to training resources for pilots. This method reinforces pilots’ intimate understanding of the policies, procedures and practices that underpin the ‘application of knowledge’ and ‘application of procedures and compliance with regulations’ competencies. However, our study found that only some participants anticipated that their competency in ‘leadership and

teamwork', 'communication', 'problem solving and decision making' and 'workload management' would decline while they were grounded. In contrast, a significant number reported a resulting decline in proficiency in these competencies (46%). The gap between anticipated decline and reported decline can strongly influence how participants prioritise their study, mainly since only one-quarter of the participants studied these four competencies. One difficulty with these competencies is that they are difficult to study at home, especially those associated with coordination with another crew member. However, they are particularly crucial for flight safety. These competencies are identified as traits of high-performing crews (McCarthy & Agnarsson, 2018) and therefore require an emphasis on return-to-operations training. The research has found that the competencies identified by the IATA (2020a) requiring special emphasis take longer to return to proficiency than other competencies. 'Situation awareness and management of information', 'workload management' and 'application of procedures and compliance with regulations' were most reported to have been perceived to have declined the most while the pilots were grounded, which provides evidence of the importance of focusing on these competencies in refresher training.

Recommendations

A common facilitated training method used by airlines is computer-based training (CBT) or e-learning. Its implementation during the pandemic was reported to have varied usefulness. While it assisted in retaining the 'application of knowledge' competency, care needs to be taken to ensure that engagement is maximised with trainees. To improve training outcomes, emphasis on 'problem solving and decision making', 'workload management' and 'situation awareness and management of information' should be incorporated within a CBT package. Many participants used cognitive rehearsal and reported the method to be instrumental in their recall of critical memory items and the preservation of procedural motor skills. Leveraging this significant utilisation, airlines should facilitate challenging table-top

exercises and complex problem-solving scenarios to provide an engaging and stimulating study tool to improve competency retention. By providing audio-visual cues, decision trees and time pressure, the realism of the scenario can be enhanced to foster engagement. Olaganathan and Amihan (2021) suggested that this could be further extended with virtual reality (VR) simulation.

Access to observation flights would provide an invaluable means of study for grounded pilots. While this training is typically used for pilots starting at a new airline or on a new fleet, none of the participants mentioned its use. These observations provide a powerful technique to allow an inactive pilot to immerse themselves in flight operations, self-recognising gaps in their competencies for future study efforts.

A safety risk exists in the return to operations for pilots when an already degraded state of workload capacity exists if a nonnormal situation arises. This issue is coupled with pandemic-related operational complexity, a lack of recent experience among the crew, and aircraft returning from long-term storage. Our research shows that a significant improvement in competency confidence was reported after six flights, particularly in ‘workload management’. Therefore, additional line-oriented simulator training is recommended to absorb the time required to regain these skills rather than during line flights. Alternatively, the use of a safety pilot for the first six flights could also mitigate the safety risk to the public, while crew members regain their confidence in flying.

Conclusions

The purpose of this study was to evaluate what airline pilots have done to preserve their skills while absent from the cockpits, to understand where reported decline in competencies were anticipated versus occurred and how self-study practices assisted returning crews to operational status. The impact of the COVID-19 pandemic on pilots has been significant. Many pilots have been grounded for more than one year, leading to a

noticeable decline in skills. Motivation for self-study varied significantly between the participants, highlighting both the hurdles and the stressors created by the pandemic. Many participants explained a disconnect between pilots and their employing airlines. The research found that pilots perceived their skill set to decline differently than it did. This was particularly evident around competencies identified as critical for high-performing crews. Confidence in the application of these competencies was found to significantly improve beyond six flights, providing evidence that the first few flights back in the aircraft carry a higher safety risk.

The required volume of refresher training that must be reinvested in for returning pilots increases with their grounded duration. This cost can be offset through the effective use of self-study training programmes. The grounded pilots favoured several study pedagogies, such as the study of operation and procedure manuals, cognitive rehearsal, and computer-based training, which were helpful for skill retention. These were mainly independently led by the participants with little intervention or assistance from their airline. The other study pedagogies were reported to have varied effectiveness.

This research contributes to the aviation community by showing that airlines should prioritise enhancing pilots' soft-skill competencies while grounded. It provides recommendations for increasing the engagement of pilots while grounded, utilising lower-cost training methods such as CBT and familiarisation with flights prior to crew returning to operations. It also provides a new understanding of the number of flights required to regain confidence in the application of pilot competencies following a period of absence from flying.

This research also had several limitations. COVID-19 created limitations around participant motivation, particularly with airline involvement, while they sought to operationally recover from the pandemic. The reliance upon online recruitment of

participants was due to travel and social distancing limitations caused by the pandemic. Some countries, such as Australia and Hong Kong, endured greater impacts on their aviation industry than North America, where different measures were taken to control the pandemic. This led to the participants in this research being more readily available but provided a participant sample that also faced difficulties related to stronger social-distance measures. The research relied on the participant's accurate self-assessment. While self-critique is commonly used in the industry, a more objective approach would yield stronger results. The use of a third-party observer, such as a check airperson, would provide additional validity and reliability. However, this is difficult to achieve on a large scale without significant airline participation. The airlines involved would also need to be aligned in utilising the IATA model, which is still in its infancy.

As the COVID-19 pandemic continues, with many pilots still operationally grounded, new research trajectories are emerging. Additional studies should consider the effectiveness of enhanced training systems to improve engagement and motivation to prevent further skill loss. Investigation into the effect of the pandemic on pilots leaving the industry and the detrimental impact on both the profession's future and on pilot shortages may identify influences that can be reversed.

Key Points

- Half of the grounded airline pilots did not engage in self-study efforts during the COVID-19 pandemic.
- The decline in skills in key competencies was underestimated and thus not regularly studied.
- Airlines are recommended to incorporate more in-depth computer-based training programmes around a broader range of pilot competencies.

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Biographies

Andrew Mizzi, **Griffith University**, andrew.mizzi@griffithuni.edu.au, <https://orcid.org/0000-0002-3094-8535>. Andrew is a pilot at Cathay Pacific Airways and a postgraduate student at Griffith University. He has a master's degree in aviation management from Griffith University, Australia (2021).

Prof. Gui Lohmann, **Griffith University**, g.lohmann@griffith.edu.au, <https://orcid.org/0000-0002-3374-9734>. Gui is a professor in aviation management at Griffith University, Australia, and a visiting scholar at the Tourism Economics and Management Research Centre at the University of São Paulo, Brazil. He has a Ph.D. in Tourism Management from Victoria University of Wellington, New Zealand (2006).

Dr. Guido Carim Junior, **Griffith University**, g.carimjunior@griffith.edu.au, <https://orcid.org/0000-0001-5258-3912>. Guido is a senior lecturer at Griffith University and has a Ph.D. in Industrial Engineering from Federal University of Rio Grande do Sul, Brazil (2016).