Knowledge, Attitude, And Practices of The Student Pilots on Having Experienced Home-Based Simulators Prior To Enrolling in Flying Schools Compared to Having None

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Abstract— **This study aimed to investigate the Knowledge, Attitude, and Practices (KAP) of student pilots with and without prior experience in home-based flight simulators before enrolling in flying schools. The study utilized a mixed-method approach to distinguish differences in the Knowledge, Attitude, and Practices (KAP) and to determine their correlations. Quantitative data analysis was used to evaluate significant disparities in student pilots' knowledge and attitude considering that some student pilots have exposure to home-based flight simulators (HFSs) before their formal training and some do not have any experience. Qualitative method was used to analyze the Practices of student pilots through interviews and their Attitudes through observation. The study revealed that there was no significant difference between student pilots with experience in HFSs and those with none, but what was identified was the distinctive attitudes and practices they showed influenced by their exposure towards home-based flight simulators (HFSs). The correlation between KAP shows the relationship between Knowledge, Attitude, and Practices. Recommendations include longitudinal study and in-depth analysis to track knowledge development over time. This includes determining factors that contribute to more insights into the student pilots' effective knowledge application during their transfer of learning to actual training. This study provides valuable insights for aviation studies to enhance student pilots' training strategies and address the diverse needs of student pilots.**

***Index Terms*—Knowledge, Attitude, Practices, Home-based Flight Simulators.**

1. Introduction

In the field of aviation education, the integration of technology has significantly transformed training environments, giving rise to the widespread availability of flight simulators. This research delves into the differences and correlations existing in the Knowledge, Attitude, and Practices of Student Pilots who have engaged with home-based simulators before enrolling in flight schools in comparison to those who lack such exposure.

The aviation industry requires a blend of theoretical knowledge and practical expertise. In difficult conditions, aspiring aviators must traverse a complex interaction of aerodynamics, meteorology, navigation, and decision-making. These abilities have traditionally been learned through practical training on actual aircraft. However, new methods of flight training have been made possible by developments in simulator technology. Before stepping into the cockpit of an actual aircraft, trainees can practice their abilities on a safe and accessible platform. As such, the use of flight simulators is crucial in-flight training programs, encompassing both high-fidelity cockpit-replica systems and more accessible low-fidelity options like Microsoft Flight Simulator and X-plane. Low-fidelity simulators provide a cost-effective yet impactful training tool for initial flight training, classroom demonstrations, procedural tasks, and instrument training (Reweti et al., 2017).

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The incorporation of affordable information technology products has led to the development of innovative personal computer-based flight simulation tools, improving the cognitive and behavioral skills of pilots and enabling valuable research in the field (Risukhin et al., 2016). Using a flight simulator to improve pilots' prior knowledge and abilities may make their flying experience more effective and enjoyable (Dinçer & Demirdöken, 2023). It also emphasizes how they fly, how the instruments function, and how they can execute flight maneuvers that give them familiarization (Koonce & Bramble, 1998). Balcerzak and Kostur (2018), stated that engaging in low-fidelity flight simulation i.e. HFS allows students to hone decision-making skills and provides highly effective training for flight crews. It also facilitates the development of specific training tasks while minimizing the environmental impact.

As modern aviation education seeks to enhance pilot training and efficiency, the application of simulation technologies becomes indispensable. The evolution of low-fidelity simulators (LFS) as alternatives to traditional high-cost, high-fidelity training devices introduced a cost-effective, efficient, and accessible means of boosting cognitive and behavioral skills among student pilots, reducing training costs, and enhancing student retention. These realistic games, X-plane, Falcon 4.0, and Microsoft Flight Simulator, are designed for entertainment purposes, lacking any purposeful or explicit instructional support. While these games enhanced generic flight skills, the Performance of the Microsoft Flight Simulator games indicated only far-transfer–transfer of more generic flight skills from the game to the test flight tasks. Despite these advantages, their integration into flight schools, especially in the early stages of training, remains limited. (Risukhin et al., 2016; Korteling et.al., 2017; Marques et al., 2022). As such, this research aims to evaluate the effect of home-based simulators on pilot training and performance by investigating the differences in knowledge acquisition, attitudes, and training practices between pilots with and without prior exposure to these simulators.

Modern Personal Computer Aviation Instruction Devices (PCATDs) have completely changed the way that aviation instruction is conducted. These innovative tools have become a viable and successful way to improve pilot education by bridging the gap between academic understanding and actual flying experience. Simulation-based learning emphasizes the "Learning by Doing" paradigm in aviation training, providing students with practical experiences that complement theoretical knowledge and showing the efficacy of simulations in facilitating the acquisition of complex skills across different domains (Ruiz et al., 2014). With a focus on their design, capabilities, advantages, and drawbacks in the context of the changing environment of aviation education, this study attempts to investigate the effects of PCATDs (i.e., Microsoft Flight Simulator and X Plane) on student pilots, especially on their transition to formal training and how they interact with their instructors. It deals with the vital topic of evaluation of training. Lintern and McMillan (2018) delved into the concept of transfer in flight simulation, addressing the challenges posed by differences in training conditions and the fidelity of simulators. Competency-based systems Approach to Training depends upon an evaluation to validate the match of training and job performance.

A student's learning experiences are crucial in shaping their self-esteem, motivation, and how they view their capabilities. These experiences can have significant consequences for their future educational pursuits, whether positive or negative. When students face and grapple with ongoing learning challenges, it can have a severe impact on their emotional well-being in all aspects. The concept of "learner self-perception" in the learning environment, as emphasized by Lee and Stankov (2012), should be a top priority. Prioritizing this aspect is essential when offering support and designing intervention programs. Confidence is a key element in the learning process, having a substantial influence on students' active involvement and academic advancement. Self-confidence is a fundamental foundation for students to explore new areas, take calculated risks, and fully engage in learning activities. Those with self-assurance have a sense of confidence in their abilities, set ambitious goals, and passionately work to achieve them, without worrying about potential setbacks, as discussed by Akbari and Sahibzada (2020).

The learning process of student pilots has multiple aspects by nature, including cognitive, emotional, and practical aspects. They emphasized the need to consider other factors beyond technical fidelity when assessing simulator training (Borgvall et al., 2008). As mentioned by Ineson et al. (2013), self-efficacy is influenced positively by prior knowledge and prior ability. Furthermore, It is extremely important to understand how they engage with desktop flight simulators at home in terms of information assimilation, skill development, and decision-making. Khalid (2021) addressed that the student's performance and retention of knowledge from different teaching modes for flight simulation such as video, and a combination of lecture and literature shows that video is the most effective mode, followed by the latter. It is also mentioned by Tabibian, et al., (2019) that practicing repetition as a technique of efficient memorization improves their long-term knowledge retention. Continuous learning by maximizing their recall probability depending on the frequency of reviewing is what they do to improve learning retention for a better transfer. This study will evaluate how well-learned information holds up over time. Elesio (2023) also conducted research regarding the significant influence of self-regulated learning strategies and the academic performance of college students. It is found that there is a significant relationship between students' self-regulated learning strategies and their academic performance.

The technology is available to supplement classroom training activities and some aspects of simulator procedure training with promising cognitive learning outcomes (Cross et al., 2023). While simulator training has shown a potential to enhance skills and knowledge, the decay of skills over time is a concern. The analysis of competence retention highlights the importance of

factors such as initial training quality, regular practice, personal attributes, and task complexity in maintaining skills Thus, exploring the relationship between the exposure to home-based simulators and the retention of pilot competencies. In terms of competence retention in safety-critical professions, initial training quality, practice, and personal factors in skill retention are important (Vlasblom et, al., 2020). Additionally, individual differences in ability, personality, and motivation to skill retention and transfer on complex simulation tasks, reveal the intricate correlation of cognitive ability, self-efficacy, openness, and declarative knowledge (Day et al., 2013).

In conclusion, flight simulators have become an important tool in aviation education and training, especially for aspiring student pilots. This research seeks to shed light on the differences and correlations in Knowledge, Attitude, and Practices of Student Pilots' exposure to home-based simulators before enrolling in flight schools. This study aims to contribute to the ongoing enhancement of pilot training methodologies and the cultivation of proficient aviators.

A. Background of the Study

Flight simulators were developed in 1982 not for the purpose of gamification, but as a technique used to simulate flight and the environment (Smith, 2023). Aviation training was characterized by a combination of traditional classroom instruction, special ground school training, and practical flight simulations. Due to advancements in technology, evolving educational approaches, and an increasing demand for skilled pilots, the field of aviation training has experienced substantial transformation. These developments in technology have led to the creation of home-based flight simulators, thereby enhancing the knowledge acquisition of aspiring pilots (Marques et al., 2022). It is worth noting that PCATDs can indeed provide a more conducive learning environment than actual aircraft. Nonetheless, it is important to acknowledge their limitations, as PCATDs can sometimes inadvertently promote the development of poor flying techniques. Despite these drawbacks, studies have demonstrated a positive transfer of training from PCATDs to real aircraft, highlighting their importance in pilot training (Reweti et al., 2017). A study concluded by Dennis & Harris (1998), in which they examined the impact of simulator training on practical flight using Microsoft Flight Simulator showed that trainees who received simulator training performed better than those who did not. These studies confirmed that simple PC simulators are effective in developing flight skills during the initial phase of flight training (Kozuba & Bondaruk, 2014). This innovation has introduced a novel dimension to aviation instruction, prompting a closer examination of the Knowledge, Attitude, and Practices (KAP) of Student Pilots who have engaged with these simulators before their formal enrollment in flight schools. It specifically targets flying schools located in Luzon, Philippines for has numerous flying schools. This provides a better background for assessing the Knowledge, Attitude, and Practices (KAP) of student pilots who engaged with home-based flight simulators before formal enrollment in flying schools. By focusing on this specific region, which serves as a hub for aviation training, the findings aim to contribute insights to the enhancement of student pilots' learning strategies. The findings of this study can help understand the differences and correlations in Knowledge, Attitude, and Practices (KAP) that the student pilots developed.

B. Theoretical Framework

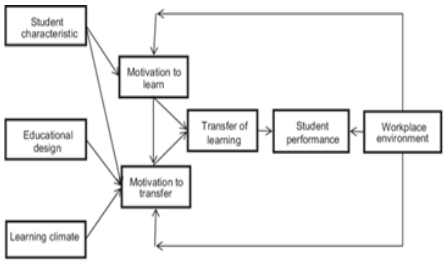

Fig.1. Systemic model of transfer of learning from Botma et al. (2013).

Transfer of learning is a machine learning approach where a model trained on one task is adapted to perform a different task. In transfer learning, the knowledge and representation learned from the source task or domain are utilized to boost performance and accelerate the learning process, often resulting in more efficient and effective learning.

Cerbin (2021) discussed that transfer of learning is the active application of an individual's accumulated knowledge and skills to unfamiliar situations. It involves taking what individuals learned in a comfortable, well-practiced environment and successfully using that knowledge or skills in a different less familiar setting. This transfer of learning can be crucial in adapting to new challenges and problem-solving in various situations. The knowledge and abilities that student pilots gain must be applied in challenging circumstances. Numerous elements, including their traits, the educational design of their courses, and the environment, have an impact on how motivated they are to study and transfer what they have learned. These elements may influence how well students succeed in a clinical setting when they must cope with difficulties and situations from real life (Botma et al., 2013).

C. Conceptual Framework

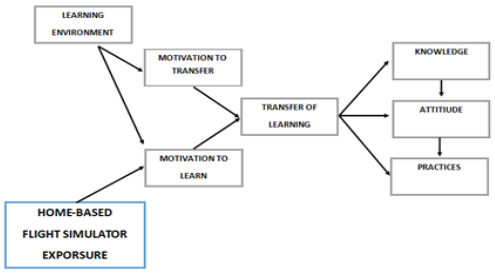

Fig.2. Framework of knowledge, attitudes, and practices about student pilots' exposure to home-based flight simulators

Transfer learning (TL) is a subfield in machine learning that solves a new learning task by applying stored knowledge to an existing learning task (Wang, et al., 2023). The study is associated with the foundations of aviation education training. It focuses on investigating the effects of pre-enrollment exposure to home-based simulators on the development of knowledge towards aviation, attitudes towards training, and practices or learning strategies they developed. The framework is based on an adopted and adapted systemic model of transfer of learning, existing learning theories, constructive alignment, and the elements of effective learning opportunities (Botma et al., 2013). The transfer of learning model focuses on how knowledge and abilities acquired in one setting or context can be transferred to another. In this scenario, it will be investigated if student pilots who have used home-based simulators can be expected to display a better transfer of theoretical knowledge and practical abilities to their formal aviation training.

In the framework, "Home-based flight simulator exposure" is the independent variable. Home-based Flight Simulator Exposure encompasses the number of hours, number of sessions, and what type of home-based flight simulator software is used in re-obtaining knowledge and familiarization with basic aircraft controls, flight procedures, and simulation of real-life scenarios in flight. In this case, "home-based flight simulator exposure" is what gives interest in this study to see how it affects other aspects, such as the knowledge, attitudes, and practices (KAP) of student pilots.

The dependent variables are considered to be what are being manipulated by the independent variables. In this study, the dependent variables are:

Knowledge, which is a set or level of understanding and expertise that student pilots possess with regards to different aspects of aviation. This can include knowledge of aircraft systems, theory of flight, flight procedures, navigation, emergency procedures, regulations, and meteorology.

Attitude refers to the beliefs, cognitive behavior, opinions, and mental disposition of student pilots during their flight training. Based on the framework, the dependent variable contains several moderator variables, which alter the effect that an independent variable has on a dependent variable, which includes ignorance, complacency, and self-efficacy.

Practices refer to the practical skills, actions, and behaviors as well that student pilots indicate during their flight training and ground school. It includes their communication skills, decision-making skills, the way they interact with their instructor, and their application of aviation knowledge.

D. Statement of the Problem

The study aimed to determine how student pilots with and without prior home-based simulator experience differ in their knowledge, attitude, and practices about aviation instruction, and their performance.

Specifically, it sought to answer the following questions:

- Is there a significant difference in the knowledge levels of student pilots who have experienced home-based simulators before enrolling in flying schools compared to those who have not?
- How can home-based flight simulators affect student pilots' attitude towards:
  - Self-efficacy in transitioning to an actual flight simulator; and
  - Interaction with their instructors
- In what specific ways do student pilots with prior experience in home-based simulators exhibit distinctive training practices and learning strategies compared to those who lack such exposure?
- How are the knowledge, attitude, and practices of the student pilots correlated?

E. Hypothesis

H0: There is no significant difference between the Knowledge, Attitude, and Practices of student pilots who have prior experience with home-based flight simulators compared to those who have not.

F. Significance of the Study

This research aimed to provide further information regarding the Knowledge, Attitude, and Practices of the student pilots on having experienced a home-based flight simulator before enrolling in flying school in contrast to having none. The results of this study will benefit the following:

Student Pilots: Future or ongoing student pilots can use this study to learn the effect of home-based flight simulators in the development of their knowledge, attitude, and practices.

Flight Instructors: This study can provide information that flight instructors can utilize to adjust the way they teach their students.

Approved Training Organizations: Approved training organizations can implement new ways of teaching i.e. Personal-Computer Aviation Training Devices (PCATDs) to better equip their students with the necessary knowledge, attitude, and practices before they enroll in flight schools.

Future Researchers: This study is a useful reference for future researchers who will conduct a study to develop and expand their research about improving pilot training and optimizing trainees' knowledge, attitude, and practice. The study suggests future research on home-based flight simulators' effectiveness in replicating real flight experiences and improving training techniques for enhanced performance in aviation training.

2. Methodology

A. Research Design

A Knowledge, Attitude, and Practices (KAP) study is a representative study of a specific population to collect information on what is known, believed, and done to a particular topic. It offers access to both quantitative and qualitative data (predefined questions formatted in standardized questionnaires). Misconceptions or misunderstandings that could be obstructions to the study's intended activities or possible barriers to behavior change are revealed by KAP

questionnaires. KAP questionnaires will determine the difference between every student pilot in some cases in this particular topic.

The study utilizes a mixed methodology, which uses both quantitative and qualitative methods. The researchers will make use of the phenomenological approach to understand the lived experiences of the participants in terms of their knowledge, attitude, and practices, combining it with a correlational approach to measure and determine the relationship of each variable. Data is gathered through questionnaires or surveys tailored to assess the student pilots' knowledge and attitudes. Also, qualitative observation was applied between the student pilots' and instructors' sessions to monitor their attitude while training. Additionally, an in-depth (one-on-one interview) is conducted to determine their practices. The results from the survey are analyzed using cross-tabulation, and thematic analysis to identify the themes and insights in their responses for the interview part.

B. Respondents

Table.1. Frequency Percentage of respondents enrolled flying school.

Approved Training Organization		
	Frequency	Percent
Flying school - A	8	53.30
Flying school - B	3	20.00
Flying school - C	4	26.70
Total	**15**	**100.00**

Table.2. Frequency Percentage of respondents' current stage in flight training.

Stage		
	Frequency	Percent
Stage 2 - Simulator Training	5	33.30
Stage 3 - Released for flying an actual aircraft	10	66.70
Total	**15**	**100.00**

Table.3. Frequency Percentage of respondents' prior experience in home-based flight simulators

Home-based Flight Simulator Experience		
	Frequency	Percent
With experience	9	60.00
Without experience	6	40.00
Total	**15**	**100.00**

The researchers' objective is to investigate how exposure to home-based flight simulators influences the student pilots' early training stages. This led to identifying the target population– student pilots currently enrolled in flying schools.

Judgment sampling is used in this study to select participants who have and do not have prior experience in using home-based flight simulators. It is based on the researchers' discretion, with an understanding of its limitations and potential for bias. The study will provide full disclosure regarding its limitations before reaching any conclusion. To determine the eligibility and ensure that the respondents were relevant to the topic objectives, the researcher built a specific criteria specifically, the current stage in the student pilot's flight training. Given the small population of student pilots per batch accepted by flying schools, the target audience of the test is at least thirty student pilots enrolled in different flying schools in central Luzon either on the simulator stage or released for the flying stage.

Due to limited time for data collection, the researchers only obtained a total of fifteen (15) respondents. The acceptance rate reached 50%, which is greater than the standard acceptance rate for external surveys equivalent to 10% - 15%. It is considered that there are only a few number of student pilots per batch, and it is further filtered to fit the criteria set by the researchers. Thus, having very limited respondents available.

Out of the respondents available, the researchers filtered out and conducted individual interviews with one representative from each flying school. Two out of the three interviewees had no prior experience with the use of home-based flight simulators and only one had prior experience.

C. Settings

The study's geographical scope is located in Central Luzon, Philippines as an ideal setting for the study due to its accessibility, convenience for data collection, and prominence in aviation training. The researchers aimed to encompass three selected flying schools that have a certificate of Approved Training Organization (ATO). The selection of only three flying schools is determined to ensure manageable ways of observation and in-depth analysis.

The study is only limited to the understanding of student pilots on basic aviation knowledge, attitudes developed through the use of home-based flight simulators in terms of their self-efficacy in transitioning to actual flight simulators and how they interact with their flight instructors, and practices they exhibit during their flight training. The criteria of selection for the

respondents is limited to student pilots who are undergoing the following stages, ground schooling stage, simulator stage, or released for actual flight training, with and without exposure to the home-based flight simulator.

D. Instrumentation

This study used a survey questionnaire to determine the Knowledge and Attitude of student pilots. Interview questions were created for Practices to determine the student pilots' application of Knowledge and Attitude toward the way they practice or perform during their formal training until they reach the simulator stage of training. The survey questionnaires were validated by three selected persons, specifically an aviation college professor, a senior student pilot, and an instructor for ground, simulator, and flying stages. This was followed by the conduct of pilot testing with a total of 30 aviation students. The selection of respondents for pilot testing was determined by using a non-probability method-judgment sampling technique. It involves the researchers by using their judgment in selecting specific individuals based on their expertise and does not rely on random selection. The questionnaires were disseminated to the participants using an online survey tool, Google Forms. The researchers utilized Google Sheets to collect the summarized data results in a tabular form. The survey questionnaires consisted of a section for profiling, and two sets: set 1 (knowledge), and set 2 (attitude). Three respondents were selected according to the results of their questionnaire for a one-on-one interview to determine their practices. The interview was conducted via Google Meet.

E. Data Analysis

The researchers used frequency percentages for the profiling of the respondents. To determine the difference between the knowledge, attitude, and practices (KAP) of student pilots with prior flight experience to those who do not have, the researchers used a t-test to measure the significant difference between the knowledge level of the respondents. Weighted mean for the attitude set, and thematic analysis for the practices set. To analyze the relationship of their KAP, qualitative cross-tabulation was utilized to determine the correlation between KAP.

F. Ethical Considerations

The researchers ensured the safety and well-being of their participants for the entire study. Student pilots from the selected flying schools were asked to participate in this study; their involvement was completely voluntary and informed. Before administering the survey questionnaires and interview, the participants were informed that they should practice awareness during their participation and how their data will be used by the researchers. The participants of the study were also not offered any incentives or compensation during the researchers' data collection. A consent was also provided for each participant before they conducted the study which included the confidentiality, procedures, benefits, and the purpose of the study to ensure ethical principles.

The researchers sough approval from specific institutions before obtaining the proper consent to conduct the study. Upon approval, the questionnaires were validated by aviation experts.

The researchers ensured that there were no names disclosed in the study such as names of persons or any institutions to remain unbiased and maintain objectivity and integrity.

3. Result And Analysis

A. Significant Difference of Knowledge levels of student pilots who have and have no experience in home-based flight simulators prior to enrolling in flying schools.

Table.4.
Frequency Percentage of responses per question

Question	Response	Frequency	Percent
Flaps is a primary control surface.	yes	4	26.70
	no	11	73.30
Pitch is a maneuver where an aircraft rotates around its longitudinal axis.	yes	4	26.70
	no	11	73.30
When an aircraft increases its pitch angle and the nose rises above the horizon, it is called climb.	**yes**	14	93.30
	no	1	6.70
Green arc in the air speed indicator shows that the aircraft is at normal operating range.	**yes**	15	100.00
	no	0	0.00
Ailerons are primary flight controls that control the movement of the aircraft about the lateral axis (pitch)	yes	3	20.00
	no	12	80.00
True altitude is read directly from the altimeter (uncorrected) when it is set to the current altimeter setting.	yes	4	26.70
	no	11	73.30
Ground speed is the actual speed of the aircraft on the ground.	**yes**	15	100.00
	no	0	0.00
The term "say again" refers to the procedure of repeating received messages back to the transmitting station in order to confirm that the message was correctly received.	yes	8	53.30
	no	7	46.70

Dirty configuration means that the airplane does not have anything on it that increases drag	yes	2	13.30
	no	13	86.70
Rudders are located on the vertical stabilizers of the aircraft	**yes**	14	93.30
	no	1	6.70

*correct answers are emphasized by bold font

Table.5.
Significant Difference of scores for the knowledge test

	Sig.	**Decision**
Knowledge Set Score	0.648	Accept

The tables show the ten (10) yes or no questions, the student pilots' responses, and the score they acquired. The T-test statistical method was used to compare the knowledge set score if there is a significant difference in the knowledge levels between the two groups–the respondents with experience in home-based simulators and those who have none. The significance level computed for the knowledge set score of both groups is 0.648 which means that there is no significant difference between their knowledge level. A contributing factor is their learning strategy; In the study of Elesio (2023), it is found that there is a significant relationship between students' self-regulated learning strategies and their academic performance. Similar to this, whether individuals have prior experience with home-based flight simulators or none, they are currently incorporating the use of these simulators into their flight training as a learning strategy, thus enhancing their academic performance. Furthermore, Ruiz et al. (2014) highlighted the potential of low-fidelity simulators, i.e. home-based flight simulators (HFSs), in enhancing the cognitive and behavioral skills of aircraft pilots during their training and development.

B. *Attitude of student pilots who have and have no experience in home-based simulators in terms of self-efficacy in transitioning to actual flight simulators and interaction with instructors*.

Table.6.
Attitude of student pilots who have no experience in HFS

Question	**Mean**	**Remarks**
I feel confident during my ground school training.	3.83	Agree
I responded enthusiastically to my instructor during lectures in ground school.	4.17	Agree
I actively seek guidance and feedback from my flight instructors after formal discussions.	4.00	Agree
I find it easier to adapt and transition to an actual flight simulator.	2.17	Disagree
I am confident in my first time on an actual flight simulator.	1.83	Disagree
I am confident in commencing Taxiing procedures on an actual flight simulator.	2.17	Disagree
I am confident in controlling the primary flight control.	3.67	Agree
I am confident in flying straight and level flights.	3.67	Agree
I am confident in executing all types of turns (i.e. Straight and Level Turn, Climbing Turn, Descending Turn)	3.33	Neither Agree nor Disagree
I am confident in executing climbs and descents.	4.00	Agree
I am confident in executing procedures regarding stall recovery.	3.50	Agree
overall mean	**3.30**	**Neither Agree nor Disagree**

Legend: "Strongly disagree (1.00-1.80)", "Disagree (1.81-2.60)", "Neither Agree nor Disagree (2.61-3.40)", "Agree (3.41-4.20)", "Strongly agree (4.21-5.00)".

Table.7.
Attitude of student pilots who have experience in HFS

Question	**Mean**	**Remarks**
I feel confident during my ground school training.	4.22	Agree

I responded enthusiastically to my instructor during lectures in ground school.	4.11	Agree
I actively seek guidance and feedback from my flight instructors after formal discussions.	4.33	Agree
I find it easier to adapt and transition to an actual flight simulator.	3.56	Agree
I am confident in my first time on an actual flight simulator.	3.56	Agree
I am confident in commencing Taxiing procedures on an actual flight simulator.	3.67	Agree
I am confident in controlling the primary flight control.	4.00	Agree
I am confident in flying straight and level flights.	4.11	Agree
I am confident in executing all types of turns (i.e. Straight and Level Turn, Climbing Turn, Descending Turn)	3.56	Agree
I am confident in executing climbs and descents.	3.89	Agree
I am confident in executing procedures regarding stall recovery.	3.44	Agree
overall mean	**3.86**	**Agree**

Legend: “Strongly disagree (1.00-1.80)”, “Disagree (1.81-2.60)”, “Neither Agree nor Disagree (2.61-3.40)”, “Agree (3.41-4.20)”, “Strongly agree (4.21-5.00)”.

Table 6 shows the responses of the student pilots who have no experience in Home-based flight simulator (HFS), while Table 7 shows the responses of those who have. Based on the results, there are no notable differences of the mean in the responses of student pilots in terms of their attitude in interacting with their instructors. As for their attitude regarding self-efficacy in transitioning to an actual flight simulator, the notable differences between the two groups are for questions 4, 5, 6, and 9 stating “I find it easier to adapt and transition to an actual flight simulator”, “I am confident in my first time on an actual flight simulator”, “I am confident in commencing Taxiing procedures on an actual flight simulator”, and “I am confident in executing all types of turns (i.e. Straight and Level Turn, Climbing Turn, Descending Turn)”. For those who do not have prior experience in HFS, Questions 4, 5, and 6 indicate low confidence or self-efficacy while question 9 is on the neutral side, on the other hand, those who have prior HFS experience, all exhibit high confidence or self-efficacy. Lee and Stankov (2012) assert that a student's self-esteem, motivation, and perception of their capabilities are heavily influenced by their learning experiences. The outcomes of these experiences can profoundly impact their future educational endeavors, either positively or negatively. Student pilots who have experience in HFS have higher self-efficacy or self-confidence in the aforementioned aspects compared to those who have none. Confidence plays a crucial role in the learning process, exerting a substantial influence on students' active participation and academic advancement. Individuals with self-assurance demonstrate confidence in their abilities, establish ambitious goals, and passionately strive to attain them, without being overly concerned about potential setbacks as discussed by Akbari & Sahibzada (2020).

Table.8.
Self-efficacy in transitioning to actual flight simulator

Question	**Mean**	**Remarks**
I feel confident during my ground school training.	4.07	Agree
I find it easier to adapt and transition to an actual flight simulator.	3.00	Neither Agree nor Disagree
I am confident in my first time on an actual flight simulator.	2.87	Neither Agree nor Disagree
I am confident in commencing Taxiing procedures on an actual flight simulator.	3.07	Neither Agree nor Disagree
I am confident in controlling the primary flight control.	3.87	Agree

I am confident in flying straight and level flights.	3.93	Agree
I am confident in executing all types of turns (i.e. Straight and Level Turn, Climbing Turn, Descending Turn)	3.47	Agree
I am confident in executing climbs and descents.	3.93	Agree
I am confident in executing procedures regarding stall recovery.	3.47	Agree
overall mean	**3.52**	**Agree**

Legend: "Strongly disagree (1.00-1.80)", "Disagree (1.81-2.60)", "Neither Agree nor Disagree (2.61-3.40)", "Agree (3.41-4.20)", "Strongly agree (4.21-5.00)".

Table.9.
Interaction with instructors

Question	**Mean**	**Remarks**
I respond enthusiastically to my instructor during lectures in ground school.	4.13	Agree
I actively seek guidance and feedback from my flight instructors after formal discussions	4.20	Agree
overall mean	**4.17**	**Agree**

Legend: "Strongly disagree (1.00-1.80)", "Disagree (1.81-2.60)", "Neither Agree or Disagree (2.61-3.40)", "Agree (3.41-4.20)", "Strongly agree (4.21-5.00)".

Table 8 shows the results on How home-based flight simulators affect student pilots' attitudes in terms of self-efficacy in transitioning to an actual flight simulator. It consists of questions answerable using a 5-point Likert scale wherein each value represents, 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree. Results were computed using a qualitative method called weighted mean for each statement. Each statement assesses the aspect of the student pilot's self-efficacy in transitioning to an actual flight simulator. Results show that the majority of the respondents responded "Agree" to questions 1, 7, 8, 9, 10, and 11. Most statements showed a positive response regarding student pilots' attitude towards self-efficacy in transitioning to an actual flight simulator if they have experience on home-based flight sim. On questions 4, 5, and 7, students answered that they "Neither agree nor disagree" on their self-efficacy relating to their transition to flight simulator training and their confidence during their first time being exposed to an actual flight simulator. Confidence is a key factor in the learning process, exerting a significant impact on students' active participation and academic progress. Those with self-assurance have a sense of confidence in their abilities, set ambitious goals, and passionately work to achieve them, without worrying about potential setbacks, as discussed by Akbari & Sahibzada (2020). Table 9 shows the questions corresponding to the interaction with their instructors. Majority of the respondents responded "Agree" to the questions 2 and 3. It shows that student pilots still interact with their instructors regardless of having experience in home-based flight simulators or not.

Through qualitative observation, the researchers discovered the attitudes of student pilots during their training. This observation supplemented the data gathered in terms of their interaction with instructors. One student pilot who has experience in Home-based flight simulators (HFSs) and one with none. Both were observed while on their ongoing simulator session along with their ground instructor. The most notable similarity observed between the two student pilots is their interaction with their instructors. In contrast, the difference between the two was the difference between their confidence level. Student pilots with experience in HFS are more familiar with the basic factors of flying, are more confident in some aspects of simulator training, and can transition better to an actual flight simulator compared to those with no experience. Student pilots with experience in HFS have the advantage in their early stages before training. HFS emphasizes how they fly, how the instruments function, and how they can execute flight maneuvers that give them familiarization (Koonce & Bramble, 1998). Additionally, Balcerzak and Kostur (2018) stated that engaging in low-fidelity flight simulation i.e. HFS is associated with positive outcomes that contribute to enhanced aviation safety.

C. Practices of student pilots during flight training, who have and have no experience in home-based simulators.

Table.10.
Themes

Master Themes	**Superordinate Themes**
Use of Home-based Flight Simulator	Experience
	Practice

Learning alternatives and strategies in studying	Self-study
Challenges in learning	Abundance of Information
Continued use of Home-based flight simulators	Advantages

Master Theme 1: Use of Home-based Flight Simulator (HFS)

Superordinate Theme 1.1: Experience

Informant 1: "Ah yes, actually we had the simulator at our dorm, so we use Microsoft Flight Simulator."

Informant 2: "Actually sir yes, I use X-Plane at home.... and the updated simulator 2023 version."

Informant 3: "Regardless, what kind of flight simulator? Yes….I do have a MS Flight Simulator in my dorm."

This theme shows the respondents' experience in Home-based flight simulators (HFSs) prior to and during flight training. The majority of the participants had already been exposed to HFSs before joining a flight training program, specifically Microsoft Flight simulator, and X-plane. Only a small number had no previous experience, but they are using it now as part of their learning strategies during flight training. Kozuba and Bondaruk (2014) highlighted the utility of flight simulators in transferring knowledge and skills acquired during basic flight training from the simulator to actual aircraft. The use of simulators, ranging from high-fidelity systems to more accessible low-fidelity ones i.e. Home-based Flight Simulators (HFSs), such as Microsoft Flight Simulator and X-plane, has become an integral component of flight training programs. HFSs offer a cost-effective yet efficient training tool for various aspects of initial flight training, classroom demonstrations, procedural tasks, and instrument training (Reweti et al., 2017). The integration of affordable information technology products has led to the development of innovative personal computer-based flight simulation tools, enhancing the cognitive and behavioral skills of pilots and fostering valuable research in the field (Risukhin et al, 2016). Additionally, The implementation of educational simulation systems can influence the "learning by doing" paradigm within a classroom setting. This approach aids students in grasping theoretical concepts and acquiring a set of skills that enhance the efficiency of performing specific tasks in a more instructive manner (Ruiz et al., 2014).

Superordinate Theme 1.2: Practice

Informant 1:"Ah yes, actually we have the simulator at our dorm, so we use Microsoft Flight Simulator. Ah Basically the home-based simulator for me actually serves as a guidance and learning experience since based on its name simulator, it is basically designed to simulate the actual operation of an aircraft so you can be able to understand and practice on how each control inputs affects the performance of an aircraft. So you will be familiarized and it help you to develop your skills in piloting an aircraft"

Informant 2: "Actually sir, yes, I use X-Plane at home.. and the updated Microsoft Simulator 2023 version. Actually, my home-based simulator helps in terms of scanning. However, when it comes to the effects of control it is quite difficult."

Informant 3: "Since here in Clark the weather … kinda abnormal, so when I get canceled to my schedule, I'll go home then simulator, Then I do practice as well the lesson first before doing it in actual flight, It will be a big help."

Practice shows how competence will decrease or increase over time. It has important factors that are related to retention (Vlasblom et al., 2020). In the aviation industry, learning does not stop. Aviation professionals need to undergo continued practice of their profession to maintain their proficiency and their license because if not, recurrency exams and check rides will be required to continue the practice of their profession. In this theme, it shows how student pilots use Home-based flight simulators (HFSs). According to the informants, HFS serves as their guidance and a way to practice and polish their skills. Additionally, it helps in familiarization and comprehension of the effects of controls on the performance of an aircraft. But in contrast, one informant emphasized the difficulty in skill transfer of this aspect. In the paper of Korteling, et al. (2017), titled "An Empirical Evaluation of Transfer-of-Training of Two Flight Simulation Games", these games or what we call HFS are designed for entertainment purposes, lacking any purposeful or explicit instructional support. While it enhanced generic flight skills, the performance of such games indicated only far-transfer which means a transfer of more generic flight skills from the game to the test flight tasks. D'Alessandro (2007) also emphasized the positive transfer of training from simulators to actual aircraft, particularly for part-task and procedural training, teaching cognitive principles, and addressing new or early-sequence tasks in training programs. HFS is also effective for recurrent training, advanced instrument flight procedures, and ongoing pilot proficiency, offering a more advantageous learning environment in certain contexts compared to real airplanes.

Master Theme 2: Learning alternatives and strategies in studying

Superordinate Theme 2.1: Self-study

Informant 1: "In terms of alternatives and learning strategies .... so, we actually watch videos …. if we want to know something about the aircraft. So for example, if you want to know how to start up an engine of a Cessna, a Cessna one seven two, so we watch videos also …. we also observe others doing the simulator. So from there we get some information here because at [confidential] the key practice is to continually observe and …. seek guidance from your seniors instructors because they have the greatest experiences, so you will learn a lot from them."

Informant 2: "Based on my own self study. If I have a schedule for flying, I usually use my notes and watch videos on Youtube."

Informant 3: "... Bunk flying and also Youtube with a mix of ground school lectures. Sometimes, I'm too lazy to open my computer, that's why I'm doing bunk fly."

Flight simulators in flying schools are not always available; each student pilot has their schedule and duration for their simulator session, so it is important to look for learning alternatives and strategies in studying to keep their knowledge fresh and maintain their proficiency. According to the informants, self-studying is their way to enhance proficiency and retain their knowledge. This includes reviewing notes, watching relevant videos, observing other student pilots' simulator sessions, and asking for guidance from their seniors and instructors. Their best way to acquire knowledge is to watch videos on YouTube because, in a way, it simulates actual lectures or discussions but is done virtually. It also provides students with visual and auditory learning, making studying more effective than reviewing their notes. In Khalid's paper (2021), various teaching modes for flight simulation, including video, lecture, and literature, were examined to assess students' performance and knowledge retention. The findings indicate that video emerges as the most effective mode, with a combination of lecture and literature following closely in terms of effectiveness. Beautemps & Bresges (2021) also discussed that watching videos for learning can provide simplified explanations and visual demonstrations which are suitable depending on the content they need to learn. According to Lintern & McMillan (2018), the impact of various training scenarios on transfer outcomes. The evidence suggests that training with a visual system contributes to transferability to an actual airplane, even though this system itself does not seem to enhance the transfer process. Noteworthy differences exist between the simulators employed for visual and non-visual training, with the visual simulator providing twice as much training as the non-visual counterpart. These distinctions in training elements may explain the improved transfer observed in the group trained with the visual simulator. Additionally, practicing repetition as a technique of efficient memorization also improves their long-term knowledge retention (Tabibian, et al., 2019).

Master Theme 3: Challenges in learning

Superordinate Theme 3.1: Abundance of Information

Informant 1: "Challenges? Of course, it will be present. So you may feel overwhelmed due to the abundance of information. So it won't be easy to understand as you need to remember multiple pieces of information. For example, procedures for startup, un-up, taxiing, takeoff, landing, emergency procedures, and different types of maneuvers. So essentially, practicing this if you have a simulator at home, you see, provides a significant advantage."

Informant 2: "Challenges? Sometimes, sir, I find it difficult to apply the information that I learned on the ground to the actual flying. This is because the words that are used may change, and I may have trouble understanding what is happening."

Informant 3: "Challenges in learning strategies, I think the number 1 is the Weather, because it creates an impact to the students if you were unable to complete the lesson within a single flight. Then the second thing is the complexity of each lesson, then the last one is the pressure to accomplish the lesson. I think that's the three main challenges of a student pilot."

Studying is one of the most common activities a student does. Some struggle and frequently encounter difficulties. This theme shows the challenges in learning that student pilots face. According to the informants, one of the difficulties is the large amount of information that they have to learn and remember, as they need to grasp the connections between different pieces of information and also keep them in mind simultaneously. Another difficulty is the correct application of the knowledge that they acquired in the actual field, where the decisions are critical and significant. Balcerzak and Kostur (2018), stated that engaging in low-fidelity flight simulation i.e HFS allows students to hone decision-making skills and provides highly effective training for flight crews. It also facilitates the development of specific training tasks while minimizing the environmental impact. Furthermore, Marques et al. (2022) discussed that despite the well-documented advantages associated with desktop simulators i.e. home-based flight simulators, there appears to be a reluctance among flight instructors to actively promote their use among students. This hesitation stems from concerns that students may develop undesirable habits if they misinterpret the instructions provided and engage in unsupervised practice sessions.

Master Theme 4: Continued use of Home-based flight simulators

Superordinate Theme 4.1: Advantages

Informant 1: "I believe that a home-based simulator offers a significant advantage like what I said earlier for pilots because it equips them with knowledge and understanding of aircraft operations. So you will already know and you will be familiarized with the different controls, different buttons. So here at [confidential], before piloting an actual aircraft, we must complete five hours of flight simulator training. So this practice allows us to be well-prepared for the actual flights. So knowing what to do in order to perform effectively."

Informant 2: "Uhh actually sir my simulator at home really

helps, it polishes my scanning. However, when it comes to the effects of control, it is quite challenging."

Informant 3: "For me and based on my own experience, home-based flight simulators do really help, not just for student pilots even on Airline Pilots, that's why there's a narrow body and wide body in different flight sim applications. And having experience in home-based flight sim really does help us, not just me before and after training, for example the taxiing procedure, the checklist, Emergency callouts etc."

The use of Home-based flight simulators (HFSs) gives significant advantages for student pilots in different aspects such as familiarization of the aircraft operations and the aircraft itself. HFSs are a useful tool to improve their learning and enhance their skills. It allows them to experience different scenarios and situations that they may encounter on real flights. It also helps them to comprehend the mechanics and operations of the aircraft. According to the respondents, they acquired various kinds of knowledge from using home-based flight simulators and improved their performance in different aspects. HFS are also useful for student pilots to practice flight procedures as they strengthen the 'procedural muscle memory' (Marques, et al., 2022).

D. Correlation between Knowledge, Attitude, and Practices of student pilots who have and have no experience in home-based flight simulators.

Table.11.
Correlation between Knowledge, Attitude, and Practices

Knowledge	Attitude	Practices
Knowledge set score obtained is 0.648 sig. which is higher than 0.05, therefore there is no significant difference.	Attitude set results show that there is a notable difference in the self-efficacy in terms of transitioning to actual flight simulator between the student pilots who have and have no prior experience in HFS and none in the way they interact with their instructors.	Continued use of Home-based flight simulators

Table.11 shows the correlation between the Knowledge, Attitude, and Practices. Given that the study contains a mixed method of both qualitative and quantitative analysis, both Knowledge and Attitude were determined using quantitative methods, while the Practices section was analyzed using a qualitative approach. The result on knowledge shows a 0.648 significance level. As discussed in 3.1, Therefore, there is no significant difference in the knowledge of student pilots who have experience on Home-based flight simulator (HFS) compared to those who have none. In the attitude section, results show that self-efficacy in transitioning to an actual flight simulator is the only notable difference between the two groups. The practices section indicates the most notable idea: Continued use of Home-based flight simulators. Knowledge, Attitude, and Practices show a correlation with each other. The Knowledge has no effect on Practices and Attitudes regarding their interaction with their flight instructors, but the latter has affected the former. According to the results and analysis discussed, the student pilots actively interact with their flight instructors, and they also find the use of HFS effective specifically in learning. As such, their knowledge level increases as they use HFSs as one of their learning strategies since there is a significant relationship between self-regulated learning strategies and the academic performance of college students (Elesio, 2023). In terms of Attitude regarding Self-efficacy in transitioning to an actual flight simulator, Knowledge and Practices affect the self-efficacy of the student pilots in transitioning to an actual flight simulator, as mentioned by Ineson et al. (2013), self-efficacy is influenced positively by prior knowledge and prior ability. Day et al. (2013) discussed the individual differences in ability, personality, and motivation in the context of skill retention and transfer on complex simulation tasks. Their findings highlight a complex interplay between cognitive ability, self-efficacy, openness, and declarative knowledge in determining how individuals retain and transfer skills in challenging simulated environments. Furthermore, Dinçer & Demirdöken (2023) stated that the utilization of a flight simulator for pilots' prior knowledge has the potential to enhance their skills, ultimately contributing to a more effective and enjoyable flying experience.

4. Discussion

A. Conclusions

Based on the results and analysis, the following were concluded:

- There is no significant difference between the student pilots who have prior experience in home-based flight simulators (HFSs). A contributing factor is their self-regulated learning strategy.
- The only notable difference in terms of Attitude of is their self-efficacy in transitioning to an actual flight simulator to those student pilots with experience in HFS and those with none in the way they interact with their instructors.
- The student pilots who had no previous experience in HFS, now use it as part of their learning strategy. It serves as a valuable tool for practice, skill development, and understanding the effect of controls on aircraft performance. However, there is a noted difficulty in the transfer of skills for the effect of controls. Student pilots face challenges in learning the vast amount of information required for flight training and applying acquired knowledge in critical real-world situations. So aside from the use of HFSs, they also engage in self-study, including reviewing notes, watching videos, and observing and seeking guidance from seniors and instructors. Overall, the continued use of HFS contributes to improved learning and skill

enhancement, gaining diverse knowledge and improving performance in various aspects of flight training.

- Knowledge, Attitude, and Practices exhibit a correlation. The relationship of Knowledge to Practices and Attitude in interactions with flight instructors is unidirectional, with the latter influencing the former. In terms of Attitude toward Self-efficacy in transitioning to an actual flight simulator, both Knowledge and Practices play a role in affecting the self-efficacy of student pilots during this transition.

B. Recommendations

- Future researchers should use a longitudinal study to track knowledge development over time that can contribute more valuable insights. They should also include the next batches of students enrolling in flying schools to increase the number of respondents. Given that prior experience with HFSs does not show a significant difference in the knowledge level of student pilots. Future researchers should also include student pilots who have zero knowledge about aviation education. A different approach of determining the knowledge of student pilots with or without home-based flight simulator experience and those without knowledge of aviation education planning to enroll in flying schools.
- Flight instructors and Approved Training Organizations can optimize their teaching methods by integrating the use of home-based flight simulators (HFS) to enhance the confidence level of their student pilots in transitioning to actual flight simulators. Acknowledge their students' willingness and active interaction in terms of seeking guidance during ground school and simulator sessions regardless of their prior experience in HFS.
- Student pilots can use these valuable insights, enabling them to enhance their learning strategies and optimize their study routines. By applying these findings, they can effectively assimilate the extensive information required for their flight training, ultimately improving their overall learning experience.
- Approved training organizations as well as Colleges or Universities with relevant undergraduate programs can benefit from this study to employ the development of structured transition programs that specifically address the shift from home-based flight simulators to actual flight training. Acknowledge the importance of both knowledge and practices in influencing the self-efficacy of student pilots during this transition. Such programs should systematically guide pilots from simulated scenarios to real-world applications.

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