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Pedagogical Skeptics and Challenges towards the Application of Drones in Teaching and Learning Sciences

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Abstract:

Drone application and implementation in various domains of work and life have transformed technology in numerous ways. Drone technology has greatly benefited various industries while also making the lives of various professionals easier in completing complex tasks in a short period. Studies proved that by introducing drones into classrooms, teachers would have a new means to make learning more fun, innovative, interactive, and collaborative for students. Drones can be applied in challenging subjects like sciences: Computer science, Biology, Physics, Chemistry, Geography, and others to clear off difficulties in some abstract concepts by giving real-world applications to the problems. However, some teachers are skeptical of the use of drones in science teaching and learning. The purpose of this paper is to investigate teachers' actions and reactions to the application and implementation of drone technology in the classroom. It goes on to explain how teachers' knowledge and professional development, students' attention being diverted to technology design and models rather than learning outcomes, a lack of adequate technical support, and fear of technological maintenance cost and sustainability all serve as barriers to proper drone implementation in the classroom. Using Google Forms, teachers (both pre-service and in-service) were asked how the aforementioned factors affect drone application. Given the time constraints for this study, a purposive sampling approach was used to recruit 60 respondents. The instrument's contents were validated with the use of the 'face validity' method. The 0.77 reliability index demonstrated that the instrument's reliability strengths were accurately positive. The collected and compiled results were analyzed

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using graphical representations for better presentation and visualization. According to the findings, teachers' knowledge of emerging technologies and professional development needs to be improved to keep up with the trend and applications of various tools that can aid effective science teaching and learning. Similarly, proper guidance is required to prevent students from becoming distracted by the fashion and gleaming designs of drones. Similarly, the government should provide maximum support to schools through subsidies to ensure technology accessibility. The functionality, safety, and care of the drones should also be maintained by the school administration. It is then suggested that frequent training and re-training for both teaching and non-teaching staff be organized to ensure proper and continuous use of drones in classrooms.

Keywords: *Pedagogy, Drones, Technology, Sciences, Teaching & learning*.

Introduction

Similar to many other new technologies, drone technology was initially created only for military purposes, fully excluding general use (Ferrández-Pastor, Garca-Chamizo, Nieto-Hidalgo, Mora-Pascual, & Mora-Martnez, 2016; Sánchez et al., 2021). There are now a variety of uses for drones in our daily lives, though, as many of these disruptive technologies have been able to break out of their initial user base and become fully accessible for use in various environments, markets, and disciplines (Moncada Sánchez, Espinosa Gómez, & Ferro Escobar, 2020). Many use cases exist in the fields of security, photography, marketing, video, and many others (Finn, 2011; Gillan, McClaran, Swetnam, & Heilman, 2019; Yaacoub & Salman, 2020; Sánchez et al., 2021). Drones are now widely available, simple to operate, highly effective, and popular technology as a result of technological advancements. Due to their capabilities, drones are now more frequently used in both academic and professional settings. Drones can and have been acknowledged as one of the useful technological instruments to advance STEM education (Ng & Cheng, 2019; Sánchez et al., 2021).

Today's drones come in a wide variety of sizes, shapes, and prices, and have a variety of features and capabilities, making them a useful and distinctive tool in schools at all

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educational levels (Sattar, Tamatea, & Nawaz, 2017). Drone technology can be incorporated into the educational system in a variety of ways to promote education given the rising interest in encouraging careers in science and technology. Drones may be seen as the newest toy advertised to attain an educational outcome, according to Joyce et al., (2020). In particular, for student-centric learning, the use of drones in education gives students new learning experiences by enhancing their involvement and motivation in the learning process. Drones give students the ability to see a problem from various angles and improve their problem-solving skills, which in turn pushes them to think critically, be creative, and offer novel solutions. Similar to how they can be utilized in practical geography instruction, biology research into the environment, plant, and animal species, geodesy terrain mapping, and medicine delivery (Lesiar & Boi, 2021).

Drones are playing a significant part in real-world problem-solving, claim Sattar et al. (2017). Drones are getting easier to use, more readily available, and more economical thanks to recent technological breakthroughs. Drone use in education is bringing about fresh ideas for engaging and inventive ways to educate and learn. Drones come in a variety of shapes and sizes, as well as with different features and abilities that increase their potential for use in education, from simple to complex and hard learning activities that are appropriate for elementary, middle, and high school levels. According to Bolick et al. (2022), there has been an upsurge in the use of drones and unmanned aerial vehicles (UAVs) in STEM fields. This indicates that the demand to incorporate UAV instruction within STEM education is expanding. Yepes et al. (2022) noted that although drones are a more prevalent reality in the public sphere, there are few scientific studies of their use in the educational setting, and their incorporation in the educational setting is still essentially nonexistent.

According to Ng and Cheng (2019), a drone is being utilized more frequently to help the teaching of science, technology, engineering, and math. Yet, incorporating drone technology into the classroom presents obstacles for teachers as well. So, it's crucial to gain a deeper comprehension of the numerous facets of incorporating drone technology into schooling. Similarly, to this, including a drone in the STEM

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curriculum promotes teaching that includes real-world experiences like observations, concept formulation, and the development of inventive and creative thinking (Jemali et al., 2022). The study is thus guided by the following research questions:

- What important implications do teachers' expertise and professional development, students use of technology to divert their attention, a lack of technical support, and concerns about the cost and sustainability of technology have for the use of drones in science education?
- Which of the important aspects most effectively explains the doubters and difficulties teachers find while incorporating drones in scientific instruction?

Related Literature

According to research, certain academics have examined the use of drones in education from various angles:

DJI Tello Edu, Parrot Mambo Fly, Robolink Codrone, Airblock, PlutoX, and other drones with affordable prices, robust sensors, and outstanding programs for usage in the educational sector were reviewed by Sanchez et al. in their study from 2021. Using a STEM framework, Joyce et al. (2020) provided a systematic method for teaching basic geospatial technology topics utilizing drones in primary/elementary, middle, secondary, and postsecondary education. After successfully engaging more than 6000 participants worldwide, they urged other researchers and business professionals who use drones in their work to similarly engage their local community to contribute to the development of a future STEM workforce that is both diverse and robust. In a similar vein, Lesiar & Boi (2021) examined how drones are currently used in Croatian schools and made projections for how they would change over time. They used readily available online resources to get pertinent data. An organized strategy for incorporating drones into teaching was revealed by the study of the data that had been gathered. They noticed two patterns of growth in the usage of drones: the first increased the number of drones in a specific institution, and the second increased the number of institutions using drones in education.

To increase student engagement and learning of new technology inside a business school curriculum, Kuzma (2018) presented

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the design of an undergraduate program in "Applied Drone Technology". It concentrated on the planning process and problems the team ran across when attempting to design something outside of the typical core business and computing curriculum. The integration of drones into a curriculum ran across several obstacles along the way, but with careful planning and a strategic vision, it was eventually successful. As a result, a module that can be used by students in a business school but also by those in other academic programs was created. In 2017, Sattar et al. offered some insight into the exploration of several drone types and their suitability for usage in teaching various courses at various levels. The goal of the research was to strengthen students' grasp of the key concepts and to foster the development of critical thinking and reasoning skills during the learning process by merging drone technology with Australian curriculum content knowledge.

For students studying natural resource science, Bolick et al. (2022) created and assessed a drone education module and laboratory practice. The study evaluated students' prior knowledge of remote sensing and drones using a variety of reusable learning objects (RLOs). Using lectures and movies of drone simulations, students were taught the procedures of data collecting and processing by drones. By working through a laboratory exercise that made use of data from previously gathered drones, students put their knowledge into practice. The effectiveness of the teaching module was assessed using an online quiz to gauge student knowledge retention and comprehension. The average exam score was 92%, showing that the lab activity on drone data collection and processing for natural resource study was successful in instructing students. Students generally had good things to say about the educational element of the drone. The laboratory exercise was interesting, according to student responses, however, some students would have appreciated a hands-on component for some aspects of the experiment. Unfortunately, due to the high cost of drones or the absence of instructor training, not all educators may have access to in-person drone training. The study showed that online training can be an effective way to expose students to drones and offered educators critical advice for creating activities with drones to increase

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access to drone-related instructional resources. Students in various STEM fields would benefit from drone instruction given the variety of drones utilized in STEM fields.

Yepes et al. (2022) investigated the viability of deploying a collection of drone-based technologies that were developed under the notion of significant learning through the application of active methodologies. The study involved 30 high school students and employed both qualitative and quantitative analyses. The qualitative data were gathered through recordings made during the interventions, the researcher's observations, and a semi-structured press interview, while the quantitative data came from the outcomes of a pre-and post-test. Finally, a triangulation of the strategies was conducted to look for elements that were consistent across the various approaches employed. The use of the technological set suggested in the pedagogical process and the likelihood of significant learning in the STEM areas by the students were found to be significantly correlated. As a result, it was discovered that the workshops with the drone-based platform helped in the understanding, construction, and interpretation of the content covered.

A group of pre-service teachers participated in a case study that was carried out using a designed-based approach, and Ng and Cheng (2019) published their findings. The study assessed teachers' preparation and training needs for adopting drone technology in their teaching. Three groups were created by random selection among the participants. They were tasked with creating lesson plans that incorporated the use of drone technology in the classroom. The TPCK framework was then used to examine the lesson plans to determine the level of preparation and training required of the teachers. Results indicated that the participants are largely competent enough to learn the information and abilities of drone technology and to incorporate it into their instruction. To fully realize the potential advantages of drone technology in education, they had to improve their pedagogical understanding, topic knowledge, and technological knowledge. It was suggested that special attention be given to strengthening instructors' subject matter expertise, technology expertise, and pedagogical expertise to apply drones in the classroom.

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By explaining the theory and practical use of drones, Jemali et al. (2022) carried out an online platform. Responses to their project were highly positive, with a level of knowledge in STEM education that had grown to 96.6% using drones as the medium. Also, from 53.4% to 89.8%, the respondents' interest in STEM fields dramatically increased. The drone-based STEM learning strategy had a favorable effect on rural students' interest and excitement, according to the results of the pre-and post-surveys.

Methodology

Teachers (both pre-service and in-service) were asked how their knowledge and professional development, students' attention being diverted by technology, a lack of technical support, their concern over the cost and sustainability of technology, and their use of drones in science classes affected the study's descriptive survey design. To gather 60 respondents, a purposive sample strategy was used. Respondents were given the option of selecting SA (Strongly Agreed), A (Agreed), D (Disagree), or SD (Strongly Disagree). The 'facial validity' method was used to validate the instrument's contents. The instrument's dependability strengths were accurately positive, as evidenced by the 0.77 reliability index. Three weeks were spent on administration and data collection, and graphical representations were used to assess the results for improved presentation and visualization.

Results

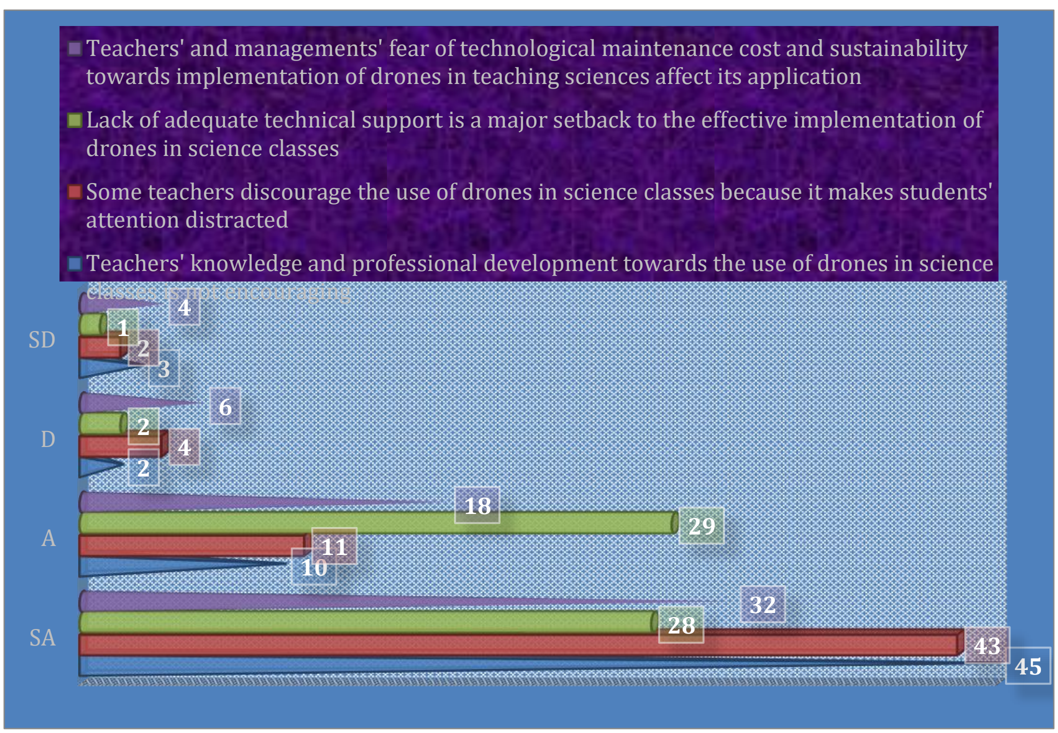

Figure 1: Implication for the use of drones in science classes

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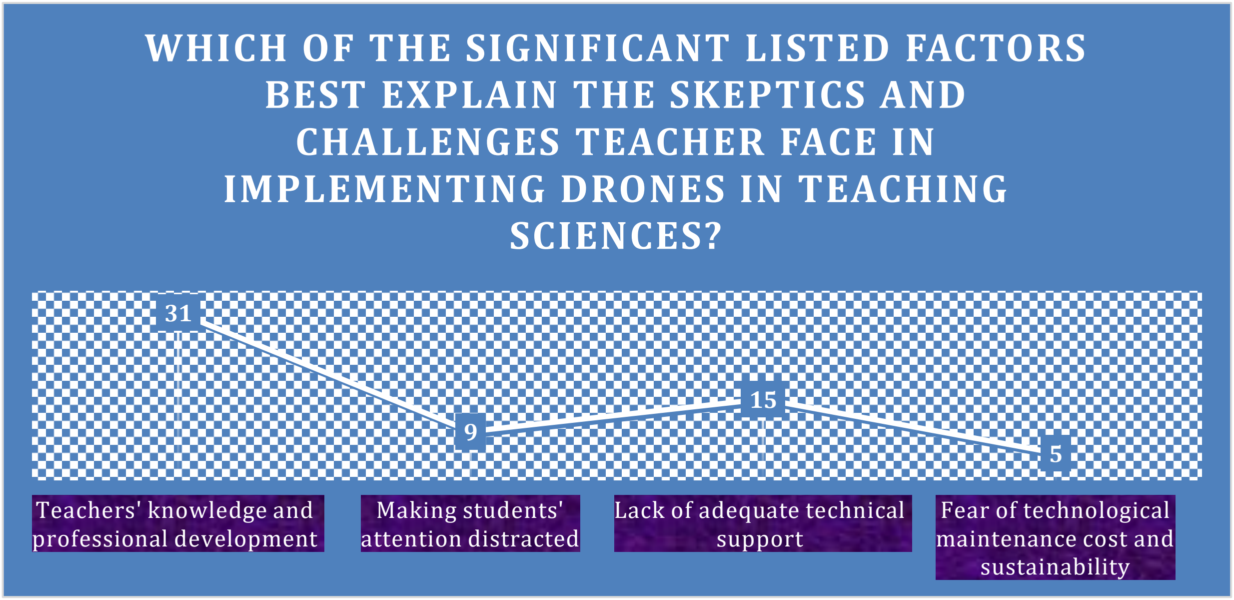

Figure 2: The best factor that explained teachers' sceptics towards the use of drones in science classes

Discussion

The visual data presentations provide a clear and vivid explanation of the implications of teacher knowledge and professional development, students' attention being diverted by technology, a lack of adequate technical support, and fear of the cost and sustainability of technological upkeep as a serious barrier to the implementation of drones in science teaching. For the 60 respondents, Fig. 1 reveals that 55 strongly agreed or agreed with the statement, "Teachers' understanding and professional growth towards the use of drones in science classes is not encouraging," while the remaining 5 respondents disagreed or strongly disagreed with the statement. The statement "Some teachers prohibit the use of drones in science lectures since it makes students' attention distracted" received support from 54 respondents, while 6 respondents expressed disagreement differently. Similar to the previous statement, just 3 respondents disagreed with the claim that "Lack of competent technical support is a serious barrier to the effective adoption of drones in science lectures," with 57 strongly agreeing or agreeing with it. The item that states that "Teachers' and

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managements' fear of technological maintenance cost and sustainability toward implementation of drones in teaching sciences affect its application" received 50 responses, of which 50 were either strongly in agreement with it or agreed with it, and 10 were against it. Out of the four previously mentioned factors, the second study question identifies the one that is most likely to explain why some teachers were hesitant to use drones in science lessons or perceived the teachers' views toward drone use as a significant issue. According to Fig. 2, the best factor that significantly contributes to the effective implementation of drones in science classes is teachers' knowledge and professional development. The next best factor, according to 15 respondents, is a lack of adequate technical support, followed by students' attention being diverted by technology (9 respondents), and 5 respondents' fear of the cost and sustainability of technology. Since a drone is a recently developed technology, it is expected that teachers may not have the necessary knowledge to use a drone in their class to increase students' learning effectiveness. This finding is supported by the fact that some educators find it challenging to meaningfully integrate technology into their classrooms. The skills and expertise of the classroom teacher, which are similar to teachers' knowledge and professional development, were listed as the first key challenge area by Joyce et al. (2020), followed by understanding and implementing the regulatory framework, including developing appropriate risk management procedures, as the second. Especially because utilizing drones in the classroom for the first time can be distracting, technical support can be difficult, and maintaining drones can be expensive, teachers are skeptical about the usage and application of drones in science education. It also stated that among the factors identified, instructors' professional development and knowledge stood out. "Technology itself cannot change the process of teaching and learning," assert Carr et al. in 1998. It is insufficient to merely provide teachers with technology. It relies on how well-informed instructors are about technology and how they can use it to drive change.

Conclusions

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Drone applications are nearly limitless; many fields and disciplines stand to gain from this cutting-edge technology; therefore, it stands to reason that drones are significant in the education sector. Drones can be used in educational settings to aid in the study of other disciplines or subjects like physics, robotics, programming, or mathematics. Students can put theoretical concepts they learn in class into reality and better understand them. For example, they can comprehend concepts like speed and distance more quickly and effectively. Drones inspire teachers and students to use their creativity, programming logic, and problem-solving abilities. Teachers must understand how to manage the usage of drones in the classroom, realize how helpful this technology is in achieving educational goals, and help students stay focused on the integration's goal because using innovative technologies like drones might divert them owing to their novelty. Drones are used in a wide range of industries and occupations. There is a need for people who are adequately and professionally educated to be able to harness all the potentials that drones give in these increasing vocations. Education for their use should be started at the lowest possible level of education.

Recommendations:

It is therefore recommended that:

- Proper guidance is required to prevent students from becoming distracted by the fashion and gleaming designs of drones.
- Similarly, the government should provide maximum support to schools through subsidies to ensure technology accessibility.
- The functionality, safety, and care of the drones should also be maintained by the school administration.
- It is then suggested that frequent training and re-training for both teaching and non-teaching staff be organized to ensure proper and continuous use of drones in classrooms.

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