Skill Development of Secondary Students for Application of Drones: Are We Ready

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Abstract

A drone refers to an unmanned aerial vehicle or a remotely piloted aircraft. Integrating drone technology into vocational education for school students can offer an exciting opportunity to them besides equipping them with valuable skills relevant to today's rapidly evolving job market. Drones have numerous applications across various industries or sectors, making them an ideal subject for vocational education. This paper explores the various aspects of integrating drone technology in education and the challenges and concerns of teaching drones to secondary students, by seeking opinion of the variety of stakeholders. The study gathered responses through an online survey regarding familiarity of the stakeholders about drones, level of interest in learning about drones and their applications, preferred subject areas for integration, specific applications of drones, perceived benefits of skill development, opinion on teaching students about coding for drones, potential enhancement of learning experiences, anticipated concerns and challenges, availability of teaching-learning materials, and interest in receiving skill training. The survey on the skill development of secondary students for the application of drones has provided valuable insights into the readiness and perspectives regarding the integration of drones into secondary education. The findings reveal that a majority of the respondents were aware about drones. The results contribute to the ongoing discourse on preparing students for the evolving technological landscape, inform future initiatives in drone education and prepare them for the future skills needed for industry 4.0. By analyzing the collected opinions, this paper provides a comprehensive understanding of the potential benefits of teaching drones, such as enhanced STEM learning, critical thinking, and problem-solving skills, as well as the challenges faced in terms of safety and privacy concerns and availability of teaching-learning materials. The paper also suggests the various aspects of drone technology, which can be integrated with subjects like Science, Maths, Social Science and Engineering or Technology.

Keywords: Skill development, drones, secondary students, STEM concepts, vocational education.

Introduction

Drones have gained significant popularity and have numerous applications across various industries. Integrating drones into vocational education can be a valuable way to equip students with knowledge and skills that are relevant to the evolving job market. Teaching students how to operate drones safely and effectively is a fundamental aspect of vocational education. They can learn about flight controls, navigation, and manoeuvres, as well as how to interpret data collected by drones. This knowledge can be applied in various sectors, such as agriculture, media and entertainment, aviation and aerospace, retail, etc. Drones require regular maintenance and occasional repairs. Teaching students how to troubleshoot and fix

common issues can prepare them for careers in drone maintenance. They can learn about the various components of a drone, coding for drones, importance of firmware updates, and how to perform basic repairs so as to ensure that the drones are in proper working order. Students can learn the basics of drone maintenance, including pre-flight checks, battery management, firmware updates, and cleaning. Common troubleshooting techniques can be taught to identify and resolve issues with drone applications. The use of drones can encourage STEM (Science, Technology, Engineering and Maths) learning and therefore, integrating various aspects of drone technology and the applications in different subjects can be one option. The other option can be offering vocational courses on drone operation, drone technology, drone maintenance, etc. for a specialised learning and occupation.

Vocational education programmes on drone operation and maintenance can focus on specific sectors, such as agriculture, construction, environmental monitoring, or emergency response services. Students can explore the applications of drones in these industries, learning how to adapt and optimize drone technology for specific tasks and challenges. Vocational education can go beyond technical skills and teach students about the business side of drone technology. Students can learn about business planning, marketing strategies and financial aspects related to starting a drone-focused enterprise. They can explore potential business opportunities within the drone industry and develop their own business ideas for becoming entrepreneurs.

Teaching drones to secondary students in vocational education requires a well-structured approach that combines theoretical knowledge with practical hands-on experiences. Integrating drones into vocational education should include educating students on the legal and ethical aspects of drone use. Students can learn about local regulations, airspace restrictions, privacy concerns, and the responsible use of drones. This knowledge is essential for future professionals to operate drones in compliance with laws and ethical guidelines.

Objectives of the Study

The objective of this survey study is to assess the need for developing the vocational courses on drone technology and applications for the secondary students. The online survey was conducted to understand the familiarity of the respondents with drones, their level of interest in learning about drones and their applications, the subject areas where drone learning could be integrated, the specific applications of drones that students find valuable, and the perceived benefits of skill development in drone operation at the secondary stage of education.

Review of Literature

Integrating drones into vocational education for higher secondary students has gained attention due to its potential impact on education and employment. Research by Anwar *et al*. (2019) highlights the transformative nature of drone technology, emphasizing its influence on educational practices, job opportunities, and privacy concerns. Eom and Sharma (2017) advocated for the use of drones in education, citing their ability to engage students and enhance learning experiences. Additionally, Eom and Yoo (2016) provided an overview of the current state of affairs regarding drones in education, emphasizing the need for comprehensive integration strategies. The review by Kim and Pae (2018) focuses on the application of drones in STEM education, highlighting their potential to foster critical thinking and problem-solving skills.

The work of Lee and Kim (2020) focuses into the development of a drone-based STEM curriculum for middle school students, providing insights into the design and implementation process. These studies collectively underscore the significance of integrating drones into vocational education, encouraging active exploration and research in this area.

This literature review critically examines the research paper by Smith, Johnson, and Anderson (2020) explores the potential advantages and hurdles associated with incorporating drones into secondary education, shedding light on the implications for teaching and learning in the digital age. The research paper highlights several key benefits of integrating drones into secondary education. Firstly, drones offer a unique opportunity to enhance student engagement and motivation. The hands-on nature of drone activities captures students' interest and promotes active learning, making complex concepts more accessible and relatable. Furthermore, the study emphasizes the positive impact of drone integration on STEM education. By integrating drones into science, technology, engineering, and mathematics classes, students gain practical exposure to these disciplines, reinforcing their understanding and application of theoretical concepts. Drones enable students to engage in real-world problem-solving, data analysis, and experimentation, thus fostering critical thinking and analytical skills.

Methodology

For data collection, a questionnaire was developed comprising a total of 12 questions designed to gather information on familiarity with drones, their interest in learning about drones and their applications, subject areas for integration, specific applications of drones, perceived benefits of drone skill development, opinions on teaching coding for drones, availability of teaching-learning materials, the potential enhancement of students' learning experiences, anticipated concerns or challenges, sectors for promoting drone education, and interest in receiving skill training on drone operations and maintenance.

Result and Discussion

89.1% of the respondents indicated that they are familiar with drones, while 10.9% stated that they were not familiar with drones (Fig.4).
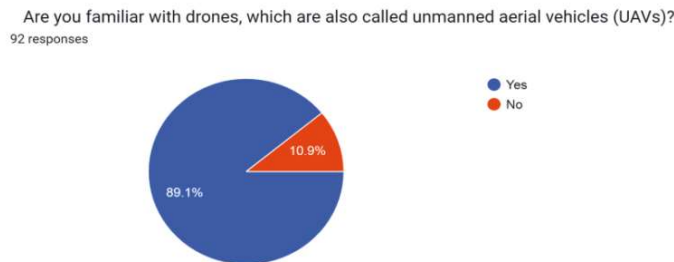

Are you familiar with drones, which are also called unmanned aerial vehicles (UAVs)?
92 responses

- Yes
- No

10.9%

89.1%

Fig. 4: Familiarity with Drones

A significant majority of respondents (75%) expressed a strong interest in learning about drones and their applications (Fig. 5). Only a small percentage (1.1%) indicated no interest. This indicates that there is great demand for courses in drone applications.
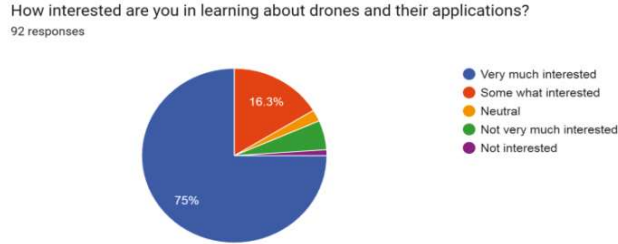
How interested are you in learning about drones and their applications?
92 responses

Fig. 5: Interest in Learning about Drones

On the question regarding integration of learning about drones with various subjects, Technology is most preferred subject, as 33.7% of the respondents suggested that for the secondary stage. Other subjects suggested for integration included Science (19.6%) and Engineering (7.6%) (Fig.6). Integration of learning about drones with subjects can significantly enhance students' understanding of STEM (Science, Technology, Engineering, and Mathematics) concepts.
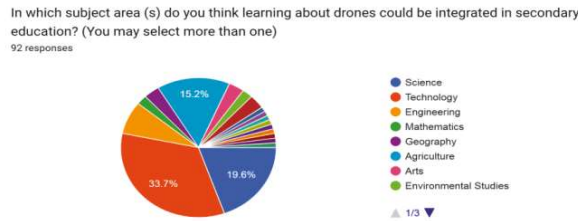
In which subject area (s) do you think learning about drones could be integrated in secondary education? (You may select more than one)
92 responses

Fig. 6: Integration of Learning about Drones with Subjects

With regard to understanding of the specific applications of drone, agricultural crop monitoring garnered the highest interest among respondents 21.7%, followed by environmental monitoring 18.5%, search and rescue operations 13% and aerial photography and videography 14.1% (Fig. 7).
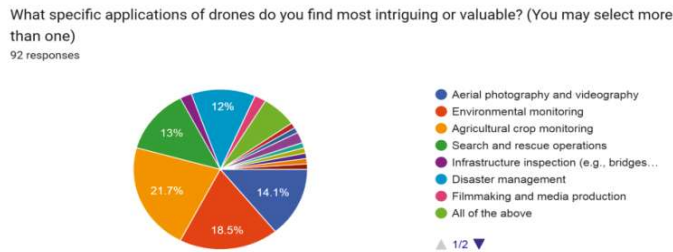
What specific applications of drones do you find most intriguing or valuable? (You may select more than one)
92 responses

Fig. 7: Specific Applications of Drones

50% of the respondents opined that skill development in drone operation at the secondary stage could provide multiple benefits, including enhanced understanding of STEM concepts, development of critical thinking skills, and problem-solving skills (Fig. 8).
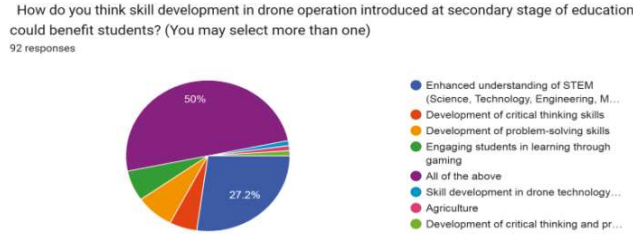
How do you think skill development in drone operation introduced at secondary stage of education could benefit students? (You may select more than one)
92 responses

- Enhanced understanding of STEM (Science, Technology, Engineering, M...
- Development of critical thinking skills
- Development of problem-solving skills
- Engaging students in learning through gaming
- All of the above
- Skill development in drone technology...
- Agriculture
- Development of critical thinking and pr...

Fig. 8: Skill development in drone operation to be introduced in secondary education

An overwhelming majority (85.9%) of the respondents agreed that schools should teach coding for drones at an early age (Fig. 9).

Do you think that schools should teach coding for Drones at an early age?
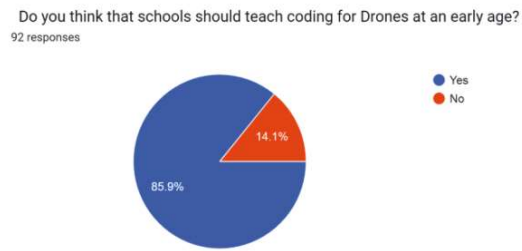92 responses

- Yes
- No

Fig. 9: Teaching Coding for Drones

Among those in favour of teaching coding, the majority 41.3% believed it should be introduced between the ages of 16 and 18, while 32.6% preferred the ages of 13 to 15 (Fig. 10).
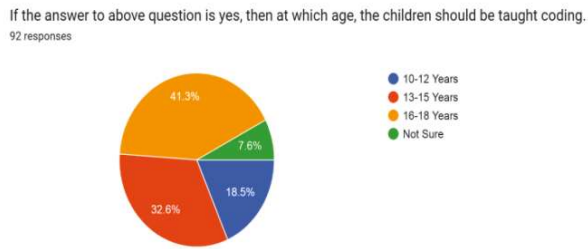
If the answer to above question is yes, then at which age, the children should be taught coding.
92 responses

- 10-12 Years
- 13-15 Years
- 16-18 Years
- Not Sure

Fig. 10: Age for Teaching Coding

Only 16.3% of respondents believed that enough teaching-learning materials were available for learning drone operation and maintenance, while 48.9% expressed the opposite opinion (Fig.11).
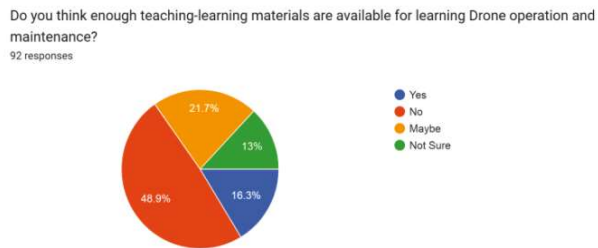
Do you think enough teaching-learning materials are available for learning Drone operation and maintenance?
92 responses

- Yes
- No
- Maybe
- Not Sure

Fig 11: Availability of Teaching-Learning Materials

A vast majority 89.1% believed that introducing drones were of the opinion that introducing teaching of drones in secondary education could enhance students' learning experiences (Fig. 12).
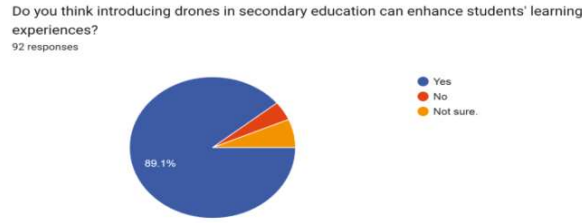
25

Do you think introducing drones in secondary education can enhance students' learning experiences?
92 responses

Fig. 12: Enhancement of Learning Experiences

The most important concerns and challenges while introducing drones in secondary education was the lack of adequate training and resources for teachers 34.8% and safety and privacy concerns 18.5% (Fig. 13).
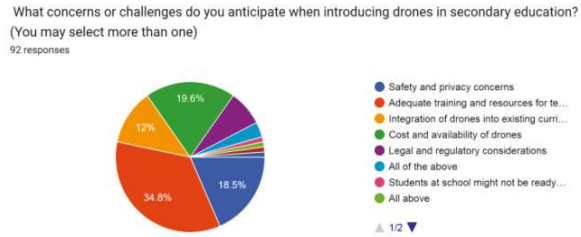

What concerns or challenges do you anticipate when introducing drones in secondary education? (You may select more than one)
92 responses

Fig. 13: Concerns and Challenges when introducing drones in secondary education

Agriculture (30.4%) and aviation/aerospace (22.6%) were the top sectors identified for promoting drone education among secondary students (Fig. 14).
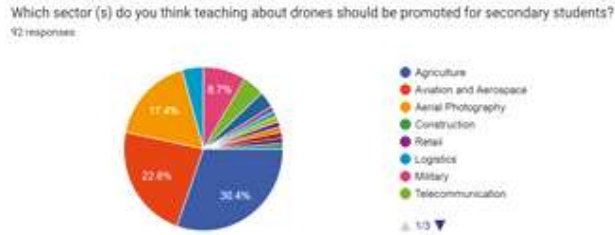

Which sector (s) do you think teaching about drones should be promoted for secondary students?
92 responses

Fig. 14: Sectors for Promoting Drone Education

A significant portion of the respondents 63% expressed a definite interest in receiving skill training on drone operations and maintenance, while 23.9% indicated they might be interested depending on the available resources (Fig. 15).
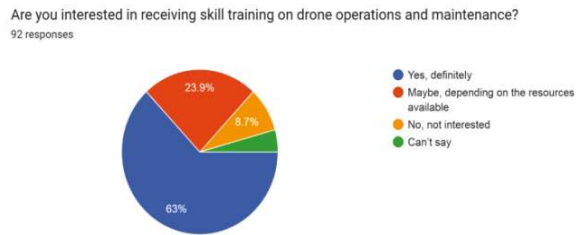

Are you interested in receiving skill training on drone operations and maintenance?
92 responses

Fig. 15: Interest in Skill Training

There is considerable interest in learning about drones and their applications, as well as enthusiasm for integrating drone education into various subject areas. Participants recognized the potential benefits of drone skill development, including enhanced understanding of STEM concepts and the development of critical thinking and problem-solving skills. However, concerns related to teacher training, availability of teaching-learning materials, and safety and privacy issues must be addressed.

Collaboration with industry experts and companies involved in drone technology can enrich the learning experience and provide real-world insights. The findings highlight the need for further exploration about the need and importance of drone education as a subject.

Conclusion

The survey on the skill development of secondary students for the application of drones has provided valuable insights into the readiness and perspectives regarding the integration of drones into secondary education. The findings reveal that a significant majority of respondents are familiar with drones and express a high level of interest in learning about drones and their applications. The subject areas considered suitable for integrating drone education span across various disciplines, including science, technology, engineering, mathematics, geography, agriculture. For example, in Science, scientific principles behind drone flight, including aerodynamics, lift, thrust, control, environmental monitoring, drone design, and flight performance can be included. In Geography, the use of drones in soil mapping, spatial analysis, creating accurate maps, studying geographic features, and collecting geospatial data for urban planning or land and agriculture management can be taught. In Mathematics, the use of drones in measurement aerial surveys and data collection, and drone-related mathematical problem-solving activities, such as calculating flight time, speed, and distances covered during a drone mission can be included as part of the syllabus. Students can be encouraged to write essays or articles about the impact of drones in various industries, such as agriculture, videography, military, etc. and conduct class debates or discussions on ethical and privacy concerns related to the use of drones as part of the syllabus for English language. In Technology or Engineering related subjects, students can learn about the components, flight control systems, and sensors and also learn about coding and programming drones using platforms like Scratch or Python. They can learn to program flight paths, capture images, or perform specific tasks. In Social studies subject, students can explore the historical background of drones, including their origins, military applications, and their evolution into commercial and recreational uses and also discuss the impact of drones on society, including their role in humanitarian aid, disaster response, and surveillance. In Arts subject, students can learn how to use drones for aerial photography and videography. They can experiment with different angles, compositions, and perspectives to learn about the various aspects of photography.

The survey results also indicate that introducing drones in secondary education can enhance students learning experiences, as an overwhelming majority of participants agree on the positive impact of drone integration. The survey outcomes emphasize the importance of addressing challenges, such as safety measures, teacher training, availability of teaching-learning materials, and cost considerations, to ensure successful integration and maximize the benefits of drones in secondary education. By nurturing their passion for technology and innovation, we can empower the next generation to embrace the opportunities and challenges presented by the exciting world of drones.

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