Teaching with Unmanned Aerial Vehicles: Perceptions of Iowa SBAE Instructors

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Introduction and Framework

Unmanned Aerial Vehicles (UAVs/drones) have recently transitioned from initial military to commercial applications (Scarcella, 2016). By 2026, UAVs are expected to produce 100,000 new jobs and an economic impact of $82 billion in the United States (Scarcella, 2016). The impact of UAVs on agriculture are no exception. Considering that this relatively untapped educational technology (Jordan, 2015) has the potential to inspire critical thinking, problem solving, and creativity (Carnahan, Crowley, Hummel, 2016); "the time has come for pioneers in Science, Technology, Engineering, and Math (STEM) integration and technology education to utilize this cutting-edge tool as both a topic and instructional device in K-12 education" (Preble, 2015, p. 24). Considering this technological call to arms and in concert with the AAAE's National Research Agenda (Roberts, Harder, & Brashears 2016), "additional research on and a better understanding of new technologies, practices, and products will help agricultural educators develop and implement agricultural teaching and learning processes…" (p. 20). Framed in Bandura's (1989) social cornitive theory, we sought to collect data to guide future STEM-based teacher training workshops through determining instructors' perceptions. The following objectives guided our inquiry: 1) describe respondents' perceived level of importance regarding teaching UAV content, and 2) describe respondents' perceived capability to teach UAV content.

Methods

This descriptive census study of Iowa SBAE teachers (N=229) used a three-part, researcher-designed instrument including 13 UAV curricular items rated on importance for agricultural education and perceived capacity to teach them. Additional demographic information was also collected. A panel of experts in agricultural mechanics education determined instrument face and content validity. A pilot test of agricultural education teachers in a nearby state (n=66) was conducted. Both constructs were determined to have excellent reliability (George & Mallory, 2003) (Importance: α=0.95, Capacity to teach: α=0.98). Following recommendations of Dillman, Smyth, and Christian (2014) and Borich (1980), we received 117 responses for a 51% response rate. We addressed non-response error by comparing respondent's demographics with Iowa Department of Education program data (Iowa, 2015). A χ^2 Goodness of fit analysis yielded no significant differences between respondents and known population demographics (Miller & Smith, 1983).

Results

Table 1 displays the perceived level of importance for integration of UAV curricular components in SBAE while Table 2 shows respondents' perceived capacity to teach them.

Importance of UAV Curricular Components as Perceived by [State] SBAE Instructors

		NI	SI	MI	VI	EI
UAV Curricular Criteria	*n*	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*
Mapping or sensing operations	85	0(0)	4(4.3)	9(7.7)	**39(28.2)**	33(28.2)
Identification of uses in agricultural settings	85	0(0)	1(0.9)	12(10.3	**43(36.8)**	29(24.8)

Student operation in authentic settings	86	0(0)	1(0.9)	21(17.9)	**37(31.6)**	27(23.1)
Manual flight control skills	86	0(0)	1(0.9)	23(19.7)	**43(36.8)**	19(16.2)
Autonomous flight control skills	86	0(0)	5(4.3)	15(12.8)	**50(42.7)**	16(13.7)
FAA regulations for UAVs	86	0(0)	6(5.1)	25(21.4)	**38(32.5)**	17(14.5)
Flight dynamics operation considerations	86	1(0.9)	3(2.6)	25(21.4)	**48(41.0)**	9(7.7)
Identification of UAV flight dynamics	86	1(0.9)	3(2.6)	25(21.4)	**48(41.0)**	9(7.7)
Autonomous control component identification	85	1(0.9)	5(4.3)	24(20.5)	**46(39.3)**	9(7.7)
Parts and functions of a UAV	86	0(0)	7(6.0)	26(22.2)	**43(36.8)**	10(8.5)
Photography or videography	85	0(0)	10(8.5)	26(22.2)	**34(29.1)**	15(12.8)
Manual control components of UAV	86	2(1.7)	10(8.5)	31(26.5)	**36(30.8)**	7(6.0)
Parts & principles of energy transfer in UAVs	86	2(1.7)	15(12.8)	**42(35.9)**	22(18.8)	5(4.3)

Note: 1=Not at all important 5=Extremely important. Mode indicated in bold.

Capacity to Teach UAV Curricular Components as Perceived by [State] SBAE Instructors

		NE	SE	ME	VE	EE
UAV Curricular Criteria	*n*	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*
Identification of uses in agricultural settings	83	13(11.1)	15(12.8)	30(25.6)	20(17.1)	5(4.3)
Student operation in authentic settings	83	19(16.2)	18(15.4)	**24(20.5)**	18(15.4)	4(3.4)
Photography or videography	82	16(13.7)	**30(25.6)**	26(22.2)	9(7.7)	1(0.9)
Manual flight control skills	83	24(20.5)	**28(23.9)**	24(20.5)	4(3.4)	3(2.6)
Mapping or sensing operations	82	23(19.7)	23(19.7)	25(21.4)	8(6.8)	3(2.6)
FAA regulations for UAVs	83	23(19.7)	23(19.7)	**29(24.8)**	7(6.0)	2(0.9)
Flight dynamics operation considerations	83	24(20.5)	**29(24.8)**	19(16.2)	7(6.0)	4(3.4)
Parts and functions of a UAV	83	24(20.5)	25(21.4)	**27(23.1)**	4(3.4)	3(2.6)
Autonomous control component identification	83	26(22.2)	**28(23.9)**	17(14.5)	8(6.8)	4(3.4)
Identification of UAV flight dynamics	83	23(19.7)	**27(23.1)**	**27(23.1)**	4(3.4)	2(1.7)
UAV components of manual control	83	24(20.5)	**28(23.9)**	24(20.5)	4(3.4)	3(2.6)
Autonomous flight control skills	83	27(23.1)	**29(24.8)**	17(14.5)	6(5.1	4(3.4)
Parts & principles of energy transfer in UAVs	83	27(23.1)	**29(24.8)**	20(17.1)	5(4.3)	2(1.7)

Note: 1=Not at all effective 5=Extremely effective. Mode indicated in bold.

Conclusions, Implications, and Recommendations

We conclude secondary agricultural education teachers are in need of training opportunities to gain knowledge and skills necessary for integrating UAVs into their SBAE curriculum. Teachers perceived all 13 curricular criteria as very important in SBAE and should be addressed; however, their capacity to teach was less effective causing a lowered expectancy of facilitating student success (Bandura, 1989). This conclusion has implications for those who develop teacher-training workshops. The discrepancy between the importance of UAV curricular criteria and teachers' capacity to teach that criteria identifies areas critical for future in-service and preservice teacher training. We recommend implementing teacher training based upon results of the Borich (1980) needs assessment model "to purposefully prioritize teaching and/or research competencies so participants can receive training in the most needed area first" (McKim, 2013, p. 1).

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