

Teaching with Unmanned Aerial Vehicles: Perceptions of Iowa SBAE Instructors

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Introduction and Framework

Initially developed for military use, Unmanned Aerial Vehicles (UAVs/drones) have recently transitioned to numerous 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 is no exception. Since this relatively untapped educational technology (Jordan, 2015) has the potential to inspire student 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). This technological call to arms aligns with the AAAE’s National Research Agenda which states, “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...” (Roberts, Harder, & Brashears, 2016, p. 20). Framed in Bandura’s (1997) self-efficacy theory, we sought to determine instructors’ perceptions regarding UAV instruction. As part of a larger study, 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 researcher-designed instrument which included 14 UAV curricular components framed in two constructs: importance for inclusion in school based agricultural education (SBAE) and respondents’ perceived capacity to teach them (Borich, 1980; McKim, 2013). Personal and program demographic information was also collected. A panel of experts in agricultural mechanics education determined instrument validity. A pilot test of agricultural education teachers from a nearby state (n=66) was conducted. Pilot instrument constructs exhibited excellent reliability (George & Mallery, 2003) (Importance: $\alpha=0.95$, Capacity to teach: $\alpha=0.98$). Following the recommendations of Dillman, Smyth, and Christian (2014), we received 117 responses from this census of Iowa SBAE teachers yielding a 51% response rate. When addressing non-response error by comparing respondents’ demographics with Iowa SBAE program data (Iowa Department of Education, 2015) as recommended by Miller & Smith (1983), a χ^2 Goodness of Fit analysis yielded no statistically significant differences.

Results

Table 1 displays respondents’ 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 Iowa SBAE Instructors

UAV Curricular Criteria	NI		SI	MI	VI	EI
	<i>n</i>	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)
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)
FAA drone licensed instructor	86	6(5.1)	16(13.7)	19(16.2)	24(20.5)	21(17.9)
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, 2=Somewhat Important, 3=Moderately Important, 4=Very Important, 5=Extremely important. Mode indicated in bold.

Capacity to Teach UAV Curricular Components as Perceived by Iowa SBAE Instructors

UAV Curricular Criteria	<i>n</i>	NE	SE	ME	VE	EE
		<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)
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)
FAA drone licensed instructor	82	43(36.8)	19(16.2)	15(12.8)	3(2.6)	2(1.7)

Note: 1=Not effective at all, 2=Slightly effective, 3=Moderately effective, 4=Very 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 thirteen of fourteen curricular criteria as very important for inclusion in the SBAE curriculum; however, their capacity to teach was less effective, potentially causing a lowered expectancy of facilitating student success (Bandura, 1997). This conclusion has implications for teacher-training workshop developers. Findings from this study identify numerous areas of UAV interest for Iowa SBAE teachers that align with a decreased capacity to teach them. 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 further research implementing 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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